

APOLLO G&N Specification
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POST-INSTALLATION CHECKOUT SPECIFICATION
FOR LM G&N SYSTEM

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	APPROVALS	
				AC	NASA
11/23/66	A	32056	1-83 Was 83 pages, now 80 pages. <i>ROB/ac</i>	EA	WLS
12/29/66	B	32480	6-46, 51, 62, 67, 73, 74, 78 <i>ROB/ac</i>	JP	--
2/27/67	C	33084	5-86 <i>ROB/ac</i>	EA	--
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7/27/67	E	34218	3, 5-7, 9-12, 14, 16-86: was 86 pages, now 84 pages. <i>JOH/ac</i>	EA	--
11/2/67	F	35010	6-94: was 94 pages, now 95 pages. <i>JOH/ac</i>	EA	--
1/12/68	G	35420	67 <i>JOH/ac</i>	EA	--
2/28/68	H	35774	3, 5, 6, 11-14, 17-21, 24, 25, 28-86: was 86 pages, now 100 pages. <i>JOH/ac</i>	EA	WLS
7/25/68	J	36568	10, 12-100, was 100 pages, now 105 pages. <i>JOH/ac</i>	EA	RJJ

This specification consists of page 1 to 105 inclusive.

APPROVALS

NASA/MSC

ACEN

<u>Paragraph No.</u>	<u>Test Title</u>
6.3.1	Standby Power In Test
6.3.2	Alarms and Interrupts Test
6.3.3	IMU Operate Power On Test
6.3.4	Temperature Control Verification
6.3.5	PGNCS Power Supply Test
6.3.6	IMU Operational Test
6.3.7	PGNCS Operational Test
6.3.8	IRIG Scale Factor Test*
6.3.9	IMU Performance Test*
6.3.10	LGC Voltage Margin Test
6.3.11	LGC Clock Frequency Test
6.3.12	Gimbal Friction Test
6.3.13	Stabilization Loop Response Test
6.3.14	G&N Fine Alignment Test
6.3.15	AOT Functional Performance Test

* To be performed periodically every sixty days.

PGNCS TESTS

FIGURE 1

6.2.4.10 CAUTION: LGC OPERATE AND IMU STANDBY power must have been applied a minimum of two hours before energizing the IMU OPERATE circuit breaker in step 6.2.4.16 unless all of the following conditions are met:

- IF:**
1. The G&N System has previously been in Standby Mode at least two hours and subsequently been in Operate Mode, AND
 2. The gimbals were placed in a parked position prior to shutdown, AND
 3. The shutdown period did not exceed 5 days, AND
 4. The Spacecraft or IMU have not been moved in any way during the shutdown period.

THEN: The two-hour standby Mode operation requirement is reduced to 15 minutes.

6.2.4.22 On the CRT, scan the power supply voltages to verify their normal operation. (No indications flashing).

6.2.4.23 After all the tests of 6.3 in Figure 1 have been completed, the General Turn-On Procedure (6.2.4) and IMU Operational Test (6.3.6) shall be completed before re-running any test. Otherwise, the testing sequence shall continue in accordance with Figure 2.

6.2.5 Interruption of Power

6.2.5.1 IMU Operate power shall never be applied without the presence of LGC Operate and IMU Standby Power.

6.2.5.2 The G&N System log book shall include the gimbal positions at time of power shutdown. If omitted, it shall be assumed that the gimbals were not parked prior to shutdown. The log book shall also state if any movement of the IMU or Spacecraft has taken place after shutdown. The times of application and removal of any bus power to the G&N System shall be recorded.

6.2.5.3 After the system has been operating with IMU Operate power on, and a power interruption occurs, immediately set the IMU Operate power circuit breaker to OFF. When power is restored a minimum of 15 minutes operation in Standby Mode is required before resuming IMU Operate power. If the power interruption was longer than 15 minutes, the G&N System shall be run in Standby Mode for a time interval at least equal to the duration power was off before resuming IMU Operate power. However, this period need not exceed two hours before application of IMU Operate power.

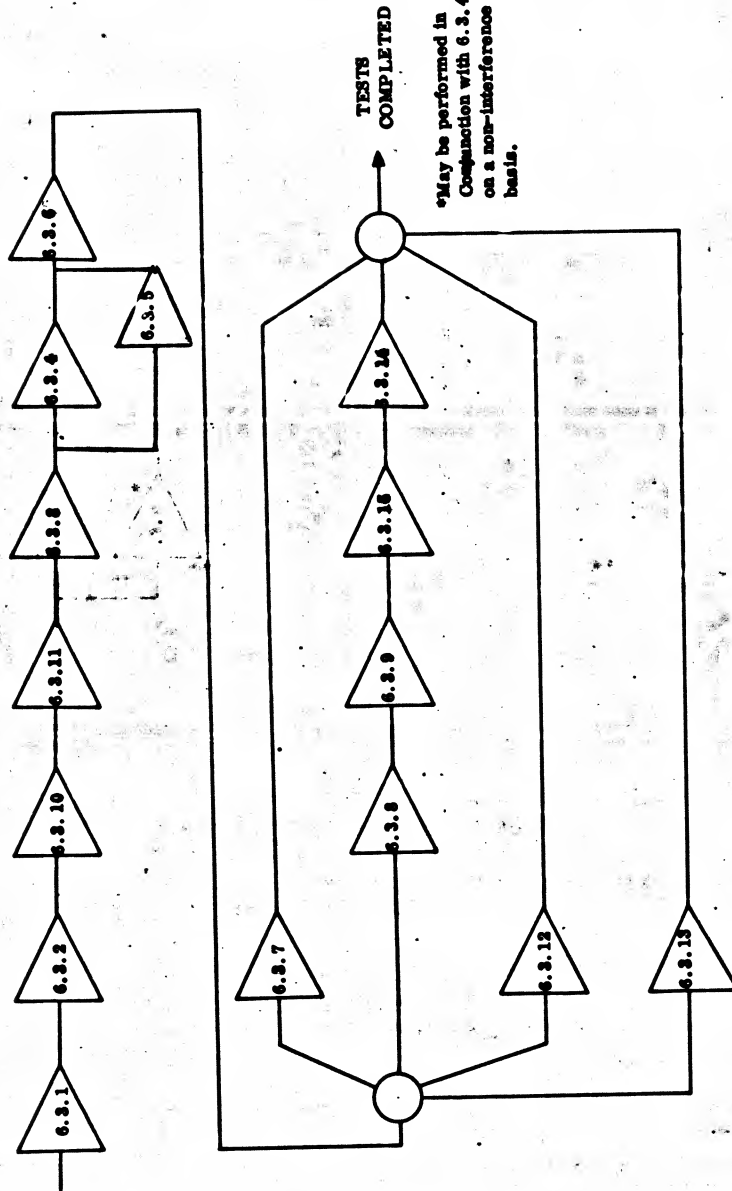
6.2.6 A warmup period of at least one hour in Operate mode is required prior to performing any test in which gyro or accelerometer parameters are measured, and at least 15 minutes prior to any test in which precision amplitude and frequency power supply checks are made.

6.3 TEST PROCEDURES

6.3.1 Standby Power On Tests

6.3.1.1 The Portable Temperature Controller, Model No. 400-31058 shall be supplying inertial component heater power to the G&N System through connector 56J1 (P230). If alarm or fail indications are present on the PTC, they shall be cleared by depressing the SYSTEM RESET pushbutton on the PTC.

6.3.1.2 Verify that spacecraft power checks, including both polarity as well as magnitude on the spacecraft power connectors, have been accomplished.



TEST PROCEDURE FLOWGRAM

FIGURE 2

6.3.1.6.2 Lamp Test

6.3.1.6.2.1 Initiate the Lamp Test by entering in the DSKY:

VERB 35 ENTR

6.3.1.6.2.2 The following DSKY displays shall illuminate for approximately 5 seconds. On CAUTION/WARNING panel, the following displays shall illuminate, then extinguish:

	LGC	
	ES	
	PCNS	
a. UP LINK ACTY	}	On concurrently for approximately 5 seconds.
b. NO ATT		
c. STEY		
d. KEY REL flashing		
e. TEMP		
f. GIMBAL LOCK		
g. PROG		
h. RESTART		
i. TRACKER		
j. OPR ERROR Flashing		
k. VERB-NOUN Flashing		
l. Plus 88888 in Row 1, Row 2, and Row 3		

8's remain in the VERB NOUN display
+8's remain in DSKY Row 1, 2 and 3 display

6.3.1.6.3 Uplink Check

6.3.1.6.3.1 On K-START 148; set LOAD/INHIBIT switch to LOAD, set TAPE/KEY switch to KEY, then enter the following:

ERROR RESET
VERB 25 NOUN 01 ENTR
02400 ENTR
+01234 ENTR
-56789 ENTR
+00000 ENTR

6.3.1.6.3.2 Verify the following is displayed on the DSKY.

VERB 23 NOUN 01
R1 + 01234
R2 - 56789
R3 + 00000

6.3.1.6.4 Downlink Check

6.3.1.6.4.1 On CRT, DSKY display, verify the following is displayed:

VERB 23 NOUN 01
R1 + 01234
R2 - 56789
R3 + 00000

6.3.1.6.5 LGC Self-Check

6.3.1.6.5.1 On K-148 enter the following sequence:

1. ERROR RSET
2. VERB 36 ENTR
3. VERB 21 NOUN 01 ENTR
4. 01362 ENTR
5. 00000 ENTR ENTR
6. 01365 ENTR
7. 00000 ENTR
8. NOUN 15 ENTR
9. 00000 ENTR ENTR
10. 00000 ENTR ENTR
11. 00000 ENTR
12. Verify REDO Counter = +00000
13. VERB 21 NOUN 27 ENTR
14. 00010 ENTR
15. VERB 15 NOUN 01 ENTR
16. 01366 ENTR

6.3.1.6.5.2 On the CRT, DSKY display, verify that R1 does not display 01102 or 41102. If a malfunction occurs, the following is displayed:

R1 01102 or 41102
R2 XXXXX c (S FAIL) program address +1 of point of failure
R3 XXXXX number of fails.

6.3.1.6.5.3 When R3 = 00002, stop the LGC Self Check by entering in K-148 the following:

VERB 34 ENTR
VERB 21 NOUN 27 ENTR
00000 ENTR

6.3.1.6.6 LGC Standby Check

6.3.1.6.6.1 On K-148, enter the following sequence:

VERB 21 NOUN 17 ENTR
+00000 ENTR

Start ACE Countdown clock upon depressing ENTR from an initial setting of 0 HRS, 0 MIN, 0 SEC. Record difference between LGC time on the CRT and the Countdown clock.

VERB 60 ENTR
Verify on CRT ABL-LGC-STBY is ON

6.3.1.6.6.2 On DSKY depress PRO pushbutton for approximately 3 seconds.

6.3.1.6.6.3 Verify STBY status indicator lamp is ON.

6.3.1.6.6.4 On the CRT, verify the 3.2 KC 28V Supply (GG1331) is between 28.04 and 29.16V RMS.

6.3.1.6.6.5 On DSKY depress PRO pushbutton for approximately 3 seconds to return to LGC OPERATE mode. If the LGC does not return to the OPERATE mode, depress the PRO pushbutton for a maximum of two additional times.

6.3.1.6.6.6 Verify STBY status indication lamp is OFF. RESTART light may be ON, verify LGC WARNING OFF. Press ERROR RESET pushbutton. Enter VERB 61 ENTR on K-148. Verify on CRT ABL-LGC-STBY is OFF. Record LGC time on the CRT and time displayed on the countdown clock simultaneously. Verify that the difference between the LGC time and countdown clock is within one second of the difference recorded in S.F. Specified in 6.3.1.6.6.1.

6.3.1.6.7 Standby/Proceed Check

6.3.1.6.7.1 On K-148 enter the following:

VERB 11 NOUN 10 ENTR
00032 ENTR

6.3.1.6.7.2 On the DSKY press and hold the PRO pushbutton. Verify Row 1 of the DSKY displays 57777.

6.3.2 Alarms and Interrupts Test

6.3.2.1 Parity Fail Test

6.3.2.1.1 On K-148 enter the following sequence

VERB 21 NOUN 02 ENTR
01600 ENTR
33777 ENTR

6.3.2.1.2 On CRT, DSKY display, verify R1 = 33777 and R3 = 01600

6.3.2.1.3 On K-148 enter the following sequence

VERB 25 NOUN 26 ENTR
04000 ENTR
01600 ENTR
00003 ENTR
VERB 30 ENTR

6.3.2.1.4 Verify RESTART lamp is ON. HALT/ION lamps are ON.

6.3.2.1.5 On K-148 enter VERB 36 ENTR. Press ERROR RESET pushbutton. All alarms shall clear.

6.3.2.2 Brupt Lock-Interrupt Too Long

6.3.2.2.1 On K-148 enter the following sequence

VERB 24 NOUN 01 ENTR
01600 ENTR
30001 ENTR
01600 ENTR
VERB 25 NOUN 26 ENTR
00001 ENTR
01600 ENTR
00003 ENTR
VERB 31 ENTR

6.3.2.2.2 Verify RESTART, lamp is ON. CAUTION lamps are ON.

6.3.2.2.3 On K-148 enter VERB 36 ENTR. Press ERROR RESET pushbutton. All alarms shall clear.

6.3.2.3 TC Trap Test

6.3.2.3.1 On K-148 enter the following sequence

VERB 21 NOUN 01 ENTR
01600 ENTR
01600 ENTR
VERB 25 NOUN 26 ENTR
04000 ENTR
01600 ENTR
00003 ENTR
VERB 30 ENTR

6.3.2.3.2 Verify RESTART, lamp is ON. CAUTION lamps are ON.

6.3.2.3.3 On K-148 enter VERB 36 ENTR. Press ERROR RESET pushbutton. All alarms shall clear.

6.3.2.4 Nightwatchman Test

6.3.2.4.1 On K-148 enter the following sequence

VERB 24 NOUN 01 ENTR
01600 ENTR
30001 ENTR
01600 ENTR
VERB 25 NOUN 26 ENTR
03400 ENTR
01600 ENTR
00003 ENTR
VERB 30 ENTR

6.3.2.4.2 Verify RESTART, lamp is ON. CAUTION lamps are ON.

6.3.2.4.3 On K-148 enter VERB 36 ENTR. Press ERROR RESET pushbutton. All alarms shall clear.

6.3.3 IMU OPERATE POWER ON TESTS

NOTE: Perform the following DSKY entries before continuing. If a VERB 36 is performed after the above information has been entered repeat lines f through j.

a. VERB 25 NOUN 01	ENTR
b. 03770	ENTR SET LOC
c. 10067	ENTR CCS NEW JOB
d. 04317	ENTR TC CHANG 1
e. 01770	ENTR TC ACTLITON
f. VERB 25 NOUN 26	ENTR CALL PRIO/DELAY
g. 01000	ENTR 01 PRIORITY
h. 01770	ENTR RELATIVE E-MEM
i. 00007	ENTR BANK ADD
j. VERB 30	ENTR REQ EXEC.

CAUTION

Prior to application of IMU OPERATE power in step 6.3.3.1.4, LGC OPERATE and IMU STANDBY power must have been applied to the G&N System continuously for a minimum of two hours. The only exception is when the requirements of step 6.2.4.10 are met and this does not apply for the initial application of IMU OPERATE power.

6.3.3.1 Verification of Power Turn-On

6.3.3.1.1 Set up analog recorder to monitor the following signals:

<u>SIGNAL NO.</u>	<u>SIGNAL NAME</u>
a. GG2136	MG Servo Error Total
b. GG2106	IG Servo Error Total
c. GG2166	OG Servo Error Total
d. GG2112	IG 1X Resolver Sine
e. GG2172	OG 1X Resolver Sine
f. GG2142	MG 1X Resolver Sine
g. GG1201	IMU 28V 1% 600 cps
h. SPARE	

6.3.3.1.2 Start analog recorder to a chart speed of 5 mm/sec. Start event recorder at a chart speed of 1 mm/sec.

6.3.3.1.3 On CRT, monitor +120 VDC PIPA SUPPLY (GG1040) and IMU gimbal angles.

6.3.3.1.4 Press in +28 VDC IMU OPERATE circuit breaker on LEM Cabin Panel 11. Record time.

6.3.3.1.4.1 Verify that the NO ATT Light on the DSKY is lighted.

6.3.3.1.5 Verify on analog recorder that the oscillations of the resolver sine signals (GG2112, GG2172, and GG2142) are not sustained and that the signals damp out within 15 seconds. If they don't, remove IMU OPERATE power as soon as possible.

6.3.3.1.6 On the CRT, verify absence of +120 VDC PIPA SUPPLY voltage for 90±10 seconds after step 6.3.3.1.4 is initiated. Verify that this voltage is between 114 and 126 after 100 seconds from step 6.3.3.1.4.

6.3.3.1.7 On event recorder verify the following:

LGC WARNING is OFF (GG9001)

ISS WARNING is OFF (GG9002)

POWER WARNING is OFF (GG9003)

6.3.3.1.7.1 On DSKY, verify that the NO ATT light is off.

6.3.3.1.8 On CRT, verify all IMU gimbal angles indicate between 358 and 002.

6.3.3.1.9 On K-148 enter the following sequence:

VERB 41 NOUN 20 ENTR

+00000 ENTR

+00000 ENTR

+00000 ENTR

6.3.4 Temperature Control Verification

6.3.4.1 Monitor the PIPA temperature during the first 15 minutes after switch from Standby Mode to the Operate Mode. The PIPA temperature shall be $130.5 \pm 2.0^\circ\text{F}$, during this period. 15 minutes after switching from Standby Mode to the Operate Mode, record the PIPA temperature. The recorded PIPA temperature shall be within 0.5°F of the Operate stabilized PIPA temperature determined below.

6.3.4.2 When 30 minutes have elapsed from the time of IMU OPERATE power turn-on record IRIG TEMP (GG2301). The IRIG temperature shall be within 0.5°F of the IRIG Operate mode stabilized temperature determined below.

6.3.4.3 30 minutes after entering the IMU OPERATE mode start recording PIPA TEMP every 5 minutes until the PIPA temperature is stabilized. The PIPA temperature shall be considered stabilized when the temperature change is less than 0.1° for 30 minutes. Record the PIPA Operate mode stabilized temperature. The PIPA Operate mode stabilized temperature shall be $130.5 \pm 1.5^\circ\text{F}$. Record the IRIG Operate mode stabilized temperature. The IRIG Operate mode stabilized temperature shall be $135 \pm 2.5^\circ\text{F}$.

6.3.4.4 The Operate Mode stabilized PIPA temperature shall be within 1.0 degree F. of the Standby Mode stabilized PIPA temperature determined in Paragraph 6.3.1.4.4.

6.3.4.5 Deleted.

6.3.4.6 Deleted.

6.3.4.7 Verify on the event record the IMU Blower Current (GG2303) and IMU Heater Current (GG 2302) "on" discretes have been present for the last hour (discretes may cycle off).

6.3.5 PQNCS Power Supply Tests

6.3.5.1 From the CRT, confirm power supply voltages (or temperatures) are as specified and record values observed.

- 6.3.5.2 The PIPA Calibration Module Temperature (GG6020) shall be between +45 and +90 DEG F.
- 6.3.5.3 The PSA Temperature (GG6021) shall be between +60 and +110 DEG F.
- 6.3.5.4 The LGC Temperature (GG4300) shall be between +45 and +130 DEG. F.
- 6.3.5.5 The +28 VDC IMU OPERATE BUS (GG1500) shall be between 24.5 and 33.5 VDC.
- 6.3.5.6 The +28 VDC IMU STANDBY BUS (GG1510) shall be between 24.5 and 33.5 VDC.
- 6.3.5.7 The +28 VDC LGC OPERATE BUS (GG1520) shall be between 23.5 and 33.5 VDC.
- 6.3.5.8 The +120 VDC PIPA Supply (GG1040) shall be between 114 and 126 VDC.
- 6.3.5.9 The -28 VDC Supply (GG1100) shall be between -21.5 and -33.5 VDC.
- 6.3.5.10 The +4 VDC CDU Supply (GG1070) shall be between 3.8 and 4.2 VDC.
- 6.3.5.11 The IMU 28V 800 CPS 1 pot Supply (GG1201) shall be between 27.44 and 28.56 VRMS.
- 6.3.5.12 The IMU 28V 800 CPS 5 pot 90 PH Supply (GG1203) shall be between 26.6 and 29.4 VRMS.
- 6.3.5.13 The IMU 28V 800 CPS 5 pot 0 PH Supply (GG1203) shall be between 25.9 and 30.1V RMS.
- 6.3.5.14 The 3.2 KC 28V Supply (GG1331) shall be between 28.04 and 29.16V RMS.
- 6.3.5.15 The 2.5 VDC T/M Bias (GG1110) shall be between 2.44 and 2.56 VDC.
- 6.3.5.16 The +14 VDC LGC Supply (GG1020) shall be between 13.6 and 14.4 VDC.
- 6.3.5.17 The +4 VDC LGC Supply (GG1030) shall be between 3.8 and 4.2 VDC.
- 6.3.5.18 The phase difference between the 3.2 KC supply and LGC sync shall be 0° ±10° (NG1336).

6.3.5.19 Record the noise levels of the following signals displayed on the CRT.

<u>Item No.</u>	<u>Measurement No.</u>	<u>Signal</u>	<u>Requirement</u>
a.	NG 1021	14 vdc LGC Noise rms	<0.4V rms
b.	NG 1031	4 vdc LGC Noise rms	<0.4V rms
c.	NG 1071	4 vdc CDU Noise rms	<1.0V rms
d.	NG 1501	28 vdc IMU Operate Noise rms	<1.0V rms
e.	NG 1511	28 vdc IMU Standby Noise rms	<1.0V rms
f.	NG 1521	28 vdc LGC Operate Noise rms	<1.0V rms

6.3.5.20 The noise peaks of the following signals are demonstrated on the event lights when the peaks have a rise time between 2 and 50 usec and the peak voltage exceeds 5 volts.

<u>Item No.</u>	<u>Measurement No.</u>	<u>Signal</u>
a.	NG 1022	14 vdc LGC Noise Peak
b.	NG 1032	4 vdc LGC Noise Peak
c.	NG 1072	4 vdc CDU Noise Peak
d.	NG 1502	28 vdc IMU Operate Noise Peak
e.	NG 1512	28 vdc IMU Standby Peak
f.	NG 1522	28 vdc LGC Operate Peak

6.3.6 IMU OPERATIONAL TEST

6.3.6.1 On K-146 enter the following:

VERB 01 NOUN 10 ENTR

00003 ENTR

Record CRT DSKY Row 1 indication AAAAA and the time of day.

6.3.6.2 On K-146 enter the following:

VERB 21 NOUN 01 ENTR

01300 ENTR

AAAAA ENTR

VERB 06 NOUN 02 ENTR

01300 ENTR

Record CRT DSKY Row 1 indication as ABBBBB

6.3.6.3 Perform the following calculations:

a. $\frac{BBBBB \times 5.12}{3600} = CCCC.C$ (Contents (hrs) of high order scalar register)

b. $23.3 - CCCC.C = DDDD.D$ hours

c. $DDD.D + \text{time of day recorded in 6.3.6.1} = \text{time of day at which high order scalar register will overflow.}$

6.3.6.4 If time of day is within 12 minutes of that calculated in 6.3.6.3.c when about to perform any of the following paragraphs, wait until that time calculated in 6.3.6.3.c has passed and proceed.

6.3.6.5 In K-148 enter the following sequence:

```

VERB 41 NOUN 20 ENTR
+00000      ENTR
+00000      ENTR
+00000      ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+17000      ENTR
+17000      ENTR
+17000      ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+27000      ENTR
+27000      ENTR
+27000      ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+00000      ENTR
+00000      ENTR
+00000      ENTR
Wait 15 seconds
VERB 57      ENTR
00004      ENTR

```

6.3.6.6 Wait 200 seconds, then verify on the CRT, that the X, Y and Z PIPA SG Output signals all indicate 0.0 ± 2.5 Volts but not 0.

6.3.6.7 Approximately 12 minutes after performing step 6.3.6.1, VERB 06 NOUN 66 shall flash.

6.3.6.8 From the CRT, DSKY display, read and record R1 and R2 (local gravity whole and fractional respectively). The value recorded shall be between 975.0 and 985.9 cm/sec².

6.3.6.9 On K-148 enter the following sequence.

VERB 33 ENTR
VERB 06 NOUN 66 shall flash

6.3.6.10 From the CRT, DSKY display, read and record the horizontal fractional component of earth rate acting on the X, Y, and Z IRIG's as displayed in R2. The value recorded shall be between .85750 and .85750.

6.3.6.11 Terminate the test by entering in K-148 the following:

VERB 33 ENTR
VERB 16 NOUN 40 DISPLAYED
VERB 34 ENTR
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR

6.3.7 PGNCB Operational Test

6.3.7.1 On K-148, enter the following sequence:

VERB 21 NOUN 01 ENTR
1220 ENTR
43733 ENTR
NOUN 15 ENTR
00006 ENTR, ENTR
03012 ENTR, ENTR
00004 ENTR, ENTR
13242 ENTR, ENTR
25563 ENTR, ENTR
01220 ENTR

6.3.7.1.1 On K-148 enter the following sequence:

a. VERB 21 NOUN 01 ENTR
b. 01300 ENTR
c. 40266 ENTR
d. NOUN 15 ENTR
e. 61304 ENTR ENTR
f. 10000 ENTR ENTR
g. 01325 ENTR ENTR
h. 00023 ENTR ENTR
i. 01325 ENTR ENTR
j. 25546 ENTR ENTR
k. 31344 ENTR ENTR
l. 54324 ENTR ENTR

m.	41345	ENTR ENTR
n.	60150	ENTR ENTR
o.	10000	ENTR ENTR
p.	01332	ENTR ENTR
q.	00050	ENTR ENTR
r.	01332	ENTR ENTR
s.	37640	ENTR ENTR
t.	04451	ENTR ENTR
u.	01337	ENTR ENTR
v.	42005	ENTR ENTR
w.	03545	ENTR ENTR
x.	04505	ENTR ENTR
y.	31315	ENTR ENTR
z.	04451	ENTR ENTR
aa.	01300	ENTR ENTR
ab.	42005	ENTR ENTR
ac.	04505	ENTR ENTR
ad.	31315	ENTR ENTR
ae.	04451	ENTR ENTR
af.	01307	ENTR ENTR
ag.	42005	ENTR ENTR
ah.	04505	ENTR ENTR
ai.	31346	ENTR ENTR
aj.	54150	ENTR ENTR
ak.	54331	ENTR ENTR
al.	05572	ENTR ENTR
am.	04505	ENTR ENTR
an.	00002	ENTR ENTR
ao.	43622	ENTR ENTR
ap.	43626	ENTR
aq.	VERB 25 NOUN 26	ENTR
ar.	00001	ENTR
as.	01300	ENTR
at.	42005	ENTR
au.	VERB 31	ENTR

6.3.7.1.2 Start the PGNCs Operational test by inserting the following sequence into K-148:

VERB 57 ENTR
00010 ENTR
Program 07 shall be displayed
VERB 33 NOUN 01 is displayed flashing

6.3.7.2 Command Accuracy 0°

6.3.7.2.1 On K-148, press ENTR

VERB 33 NOUN 02 is displayed flashing
On Event Module 1B8 WARNING Lamp may light
Press ENTR
VERB 33 NOUN 03 is displayed flashing

6.3.7.2.2 Read and record the CRT indication of IMU gimbal angles. The indications shall be 000 ± 001 degrees.

6.3.7.2.3 Read and record CRT the DSKY Row 1, 2, and 3 indications. The indications shall be $+00000 \pm 00007$.

6.3.7.3 Command Accuracy 45° .

6.3.7.3.1 On K-148, press ENTR, VERB 33 NOUN 04 is displayed flashing after approximately 20 seconds.

6.3.7.3.2 Read and record the CRT indication of IMU gimbal angles. The indications shall be 045 ± 001 degrees.

6.3.7.3.3 Read and record the CRT DSKY Rows 1, 2, and 3 indications. The indications shall be $+04500 \pm 00007$.

6.3.7.4 CDU Repeating Accuracy 45°

6.3.7.4.1 On K-148 press ENTR. In about 90 seconds VERB 05 NOUN 30 is displayed flashing.

6.3.7.4.2 Read and record the CRT DSKY Rows 1, 2, and 3 indications. The indications shall be between 77774 and 00003.

6.3.7.5 Command Accuracy 90°

6.3.7.5.1 On K-148 Press VERB 33, ENTR. In approximately 20 seconds VERB 33 NOUN 06 is displayed flashing. The GIMBAL LOCK lamp on DSKY shall be lighted.

6.3.7.5.2 Read and record the CRT indication of IMU gimbal angles. The indications shall be 090 ± 001 degrees.

6.3.7.6.3 Read and record the CRT DSKY Rows 1, 2, and 3 indications. The indication shall be +09000±00007.

6.3.7.6 Command Accuracy 135°

6.3.7.6.1 On K-148 press ENTR. In approximately 20 seconds VERB 33 NOUN 07 is displayed flashing.

6.3.7.6.2 Read and record the CRT indication of IMU gimbal angles. The indications shall be 135±001 degrees.

6.3.7.6.3 Read and record the CRT DSKY Rows 1, 2, and 3 indications. The indications shall be +13500±00007.

6.3.7.7 On K-148 press ENTR. In approximately 20 seconds VERB 33 NOUN 10 is displayed flashing. The GIMBAL LOCK lamp on DSKY shall not be lighted.

6.3.7.8 CDU Repeating Accuracy 135°

6.3.7.8.1 On K-148 press ENTR pushbutton. In about 90 seconds, VERB 05 NOUN 30 is displayed flashing.

6.3.7.8.2 Read and record the CRT DSKY Rows 1, 2, and 3 indications. The indications shall be between 77774 and 00003.

6.3.7.9 + Gimbal Lock Test

6.3.7.9.1 On K-148, Press VERB 33, ENTR. In approximately 20 seconds VERB 33 NOUN 12 is displayed flashing. The GIMBAL LOCK lamp on DSKY shall be lighted.

6.3.7.10 Command Accuracy 225°

6.3.7.10.1 On K-148 press ENTR. In approximately 20 seconds, VERB 33, NOUN 13 is displayed flashing.

6.3.7.10.2 Read and record the CRT indication of IMU gimbal angles. The indication shall be 225±001 degrees.

6.3.7.10.3 Read and record CRT DSKY Rows 1, 2, and 3 indications. The indications shall be +225±00007.

6.3.7.11 On K-148 press ENTR. In approximately 20 seconds VERB 33 NOUN 14 is displayed flashing. The GIMBAL LOCK lamp shall not be lighted.

6.3.7.12 CDU Command Rate Test

6.3.7.12.1 On K-148 press ENTR. In approximately 30 seconds VERB 06 NOUN 66 is displayed flashing. The GIMBAL LOCK lamp on DSKY shall be lighted.

6.3.7.12.2 Read and record the CRT DSKY Row 1, 2, and 3 indications. The indication shall be between 00012 and 00016.

6.3.7.12.3 On K-148 insert VERB 33 ENTR. In approximately 30 seconds VERB 06 and NOUN 66 is displayed flashing. Repeat 6.3.7.12.2. The GIMBAL LOCK lamp on DSKY shall not be lighted.

6.3.7.12.4 On K-148 insert VERB 33 ENTR. In approximately 30 seconds VERB 06 and NOUN 66 is displayed flashing. Repeat 6.3.7.12.2. The GIMBAL LOCK lamp on the DSKY shall not be lighted.

6.3.7.13 Command Accuracy 315°.

6.3.7.13.1 On K-148 insert VERB 33 ENTR. In approximately 20 seconds VERB 33 NOUN 20 will be displayed flashing.

6.3.7.13.2 Read and record CRT indication of IMU gimbal angles. The indications shall be 315±001 degrees.

6.3.7.13.3 Read and record the CRT DSKY rows 1, 2, and 3 indications. The indications shall be +315±00007.

6.3.6.14 CDU Repeating Accuracy 315°

6.3.7.14.1 On K-148 press ENTR. In approximately 90 seconds VERB 05 NOUN 30 is displayed flashing.

6.3.7.14.2 Read and record the CRT DSKY Rows 1, 2, and 3 indications. The indications shall be between 77774 and 00003.

6.3.7.15 -Gimbal Lock Test

6.3.7.15.1 On K-148 Press VERB 33 ENTR. In approximately 20 seconds VERB 33, NOUN 22 is displayed flashing. The GIMBAL LOCK lamp on DSKY shall be lighted.

6.3.7.15.2 On K-148 Press ENTR. In approximately 20 seconds VERB 33 NOUN 23 will be displayed flashing. <

6.3.7.15.3 Read and record the CRT DSKY rows 1, 2, and 3 indications. The indications shall be

Row 1 22500±00007

Row 2 22500±00007

Row 3 00000±00007

6.3.7.16 CDU Repeating Accuracy 225°

6.3.7.16.1 On K-148, press ENTR. In about 90 seconds, VERB 05 NOUN 30 is displayed flashing.

6.3.7.16.2 Read and record the CRT DSKY rows 1, 2, and 3 indications. The indication shall be between 77774 and 00003.

6.3.7.17 On K-148 Press VERB 33 ENTR. The GIMBAL LOCK lamp shall not be lighted. VERB 21, NOUN 22 is displayed flashing.

6.3.7.18 IMU CDU Fine Fail Test

6.3.7.18.1 On K-148 insert the following sequence

+00100 ENTR
+00100 ENTR
+00100 ENTR

On Event Module verify that ISS WARNING lamp lights in approximately 90 seconds.

6.3.7.18.2 After approximately 20 seconds, VERB 01 NOUN 10 shall be displayed. Verify that CRT DSKY display Row 1 indicates 33XXX or 32XXX.

6.3.7.19 IMU CDU Coarse Fail Test

6.3.7.19.1 On K-148, insert the following sequence:

VERB 25 NOUN 26 ENTR
00001 ENTR
01300 ENTR
42005 ENTR
VERB 31 ENTR
VERB 33 ENTR
+03375 ENTR
+03375 ENTR
+03375 ENTR

On Event Module, verify that ISS WARNING lamp lights in approximately 90 seconds.

6.3.7.19.2 After approximately 20 seconds, VERB 01 NOUN 10 shall be displayed. Verify that CRT DSKY display of Row 1 indicates 33XXX or 32XXX.

6.3.7.20 FDAI Linearity Test

6.3.7.20.1 On K-148, enter the following:

VERB 21 NOUN 01 ENTR
2545 ENTR
1220 ENTR
VERB 33 ENTR
VERB 33 NOUN 27 shall be displayed

6.3.7.20.2 On CRT verify the following:

PITCH ATT ERROR is between +15.3 and +18.7 DEG (GG2219)
YAW ATT ERROR is between +15.3 and +18.7 DEG (GG2249)
ROLL ATT ERROR is between +15.3 and +18.7 DEG (GG2279)

6.3.7.20.3 On K-148, enter the following:

VERB 21 NOUN 01 ENTR
2545 ENTR
01225 ENTR
VERB 23 ENTR
VERB 23 NOUN 20 shall be displayed

6.3.7.20.4 On CRT verify the following:

PITCH ATT ERROR is between +14.4 and +17.6 DEG (GG2219)
YAW ATT ERROR is between +14.4 and +17.6 DEG (GG2249)
ROLL ATT ERROR is between +14.4 and +17.6 DEG (GG2279)

6.3.7.20.5 On K-148, enter the following:

VERB 21 NOUN 01 ENTR
2545 ENTR
01225 ENTR
VERB 33 ENTR
VERB 33 NOUN 31 shall be displayed.

6.3.7.20.6 On CRT verify the following:

PITCH ATT ERROR is between +05.4 and +06.6 DEG (GG2219)
YAW ATT ERROR is between +05.4 and +06.6 DEG (GG2249)
ROLL ATT ERROR is between +05.4 and +06.6 DEG (GG2279)

6.3.7.20.7 On K-148, enter the following:

VERB 21 NOUN 01 ENTR
2545 ENTR
01225 ENTR
VERB 33 ENTR
VERB 33 NOUN 32 shall be displayed.

6.3.7.20.8 On CRT verify the following:

PITCH ATT ERROR is between +00.2 and -00.2 DEG (GG2219)
YAW ATT ERROR is between +00.2 and -00.2 DEG (GG2249)
ROLL ATT ERROR is between +00.2 and -00.2 DEG (GG2279)

6.3.7.20.9 On K-148, enter the following:

VERB 21 NOUN 01 ENTR
2545 ENTR
01225 ENTR
VERB 33 ENTR
VERB 33 NOUN 33 shall be displayed

6.3.7.20.10 On CRT verify the following:

PITCH ATT ERROR is between -05.4 and -06.6 DEG (GG2219)
YAW ATT ERROR is between -05.4 and -06.6 DEG (GG2249)
ROLL ATT ERROR is between -05.4 and -06.6 DEG (GG2279)

6.3.7.20.11 On K-148 enter the following:

VERB 21 NOUN 01 ENTR
2545 ENTR
01225 ENTR
VERB 33 ENTR
VERB 33 NOUN 34 shall be displayed.

6.3.7.20.12 On CRT verify the following:

PITCH ATT ERROR is between -14.4 and -17.6 DEG (GG2219)
YAW ATT ERROR is between -14.4 and -17.6 DEG (GG2249)
ROLL ATT ERROR is between -14.4 and -17.6 DEG (GG2279)

6.3.7.20.13 On K-148, enter the following:

VERB 21 NOUN 01 ENTR
2545 ENTR
01285 ENTR
VERB 33 ENTR
VERB 33 NOUN 36 shall be displayed.

6.3.7.20.14 On CRT verify the following:

PITCH ATT ERROR is between -15.3 and -18.7 DEG (GG2219)
YAW ATT ERROR is between -15.3 and -18.7 DEG (GG2249)
ROLL ATT ERROR is between -15.3 and -18.7 DEG (GG2279)

6.3.7.21 On K-148 enter VERB 36 ENTR. The proper operation of the IMU CAGE function (consisting of steps 6.3.7.21 thru 6.3.7.23) need be performed only once during the initial PGNCs Operational Test and omitted from subsequent testing of test 6.3.7.

6.3.7.21.1 On K-148 enter the following sequence:

VERB 41 NOUN 20 ENTR
+00500 ENTR
+00500 ENTR
+00500 ENTR

6.3.7.21.2 On the CRT, verify all IMU gimbal angles indicate between 003 and 007 DEG.

6.3.7.21.3 On analog recorder, monitor the following signals:

	<u>SIGNAL NO.</u>	<u>SIGNAL NAME</u>
a.	GG2136	MG Servo Error Total
b.	GG2106	IG Servo Error Total
c.	GG2166	OG Servo Error Total
d.	GG2112	IG 1X Resolver Sine
e.	GG2172	OG 1X Resolver Sine
f.	GG2142	MG 1X Resolver Sine
g.	GG1201	IMU 28V 1% 800 cps

6.3.7.21.4 Start analog recorder to a chart speed of 5 mm/sec.

6.3.7.21.5 On LEM Cabin Panel 4, hold IMU CAGE momentary toggle switch in the ON position. (Do not release).

6.3.7.21.6 On analog recorder, verify the 1X Resolver Sine signals (GG2112, GG2172, GG2142) null out to less than 0.5V rms. Release IMU CAGE switch to the OFF position. Disregard any momentary transients on the 1X Resolver Sine signals when the switch is released. Any sustained oscillations shall be cause for immediate removal of IMU Operate power.

6.3.7.21.7 On the CRT, verify all IMU gimbal angles indicate between 358 and 002.

6.3.7.22 Stop analog recorder.

6.3.7.22.1 On K-148 insert the following:

VERB 43 ENTR
+01700 ENTR
+00600 ENTR
-01700 ENTR

On CRT verify the following:

YAW ATT ERROR is between +15.3 and +18.7 Deg. (GG2249).
PITCH ATT ERROR is between +05.4 and +06.6 Deg (GG2219).
ROLL ATT ERROR is between -15.3 and -18.7 Deg (GG2279).

6.3.7.23

VERB 36 ENTR
VERB 41 NOUN 20 ENTR
+00800 ENTR
+00100 ENTR
-00800 ENTR

6.3.7.24 On CRT verify the following:

OG 1X Resolver Sin (11°) is between +00.50° and +00.50° (GG2181).
IG 1X Resolver Sin (11°) is between -00.50 and +00.50 Deg (GG2121)
MG 1X Resolver Sin (11°) is between -00.50 and -00.50 Deg (GG2181).

6.3.7.25 On K-146 enter the following:

VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR

6.3.8 IRIG Scale Factor Determination

6.3.8.1 Insure that the IMU Operate power and LGC Operate power have been applied for a minimum of one hour and that the IMU is not in a gimbal lock condition.

6.3.8.2 On meter module monitor and record IRIG TEMP (GG2301) and PIPA TEMP (GG2300).

6.3.8.3 On K-148 enter the following sequence:

VERB 57 ENTR
00005 ENTR

6.3.8.4 PROG 07 shall be displayed.

6.3.8.5 VERB 06 NOUN 61 shall flash.

6.3.8.6 On the CRT DSKY, Verify contents of Row 1 (Navigation Base azimuth) and Row 2 (Site latitude shall be displayed).

6.3.8.7 If values for Row 1 and Row 2 are correct, proceed to the next step.

If values for Row 1 and Row 2 are incorrect, enter the following sequence into K-148:

VERB 24 ENTR
~~XXXXXX~~ ENTR (Correct navigation base azimuth)
~~448748~~ ENTR (Correct site latitude)
Verify values in Row 1 and Row 2 are correct.

6.3.8.8 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
+00001 ENTR

NOTE: If PROG lamp changes from 07 to 00 during next step or PROG ALARM is on, enter VERB 36 ENTR and repeat steps 6.3.8.3 through 6.3.8.8.

6.3.8.9 In approximately 200 seconds VERB 06 NOUN 66 shall flash.

Read and record from CRT DSKY Row 1 (*X IRIG Scale Factor error in part per million, Position +00001)

6.3.8.10 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
+00002 ENTR

NOTE: If PROG lamp changes from 07 to 00 during next step or PROG ALARM lamp is on, enter VERB 36 ENTR and repeat steps 6.3.8.3 through 6.3.8.7 and 6.3.8.10.

6.3.8.11 In approximately 200 seconds VERB 06 NOUN 66 shall flash.
Read and record from CRT DSKY Row 1 (+Y IRIG Scale Factor error in parts per million, Position +00002).

6.3.8.12 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
+00003 ENTR

NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM lamp is ON, enter VERB 36 ENTR and repeat steps 6.3.8.3 through 6.3.8.7 and 6.3.8.12.

6.3.8.13 In approximately 200 seconds VERB 06 NOUN 66 shall flash.
Read and record from CRT DSKY Row 1 (+Z IRIG Scale Factor error in parts per million, Position +00003).

6.3.8.14 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash).
-00001 ENTR

NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM lamp is on, enter VERB 36 ENTR and repeat steps 6.3.8.3 through 6.3.8.7 and 6.3.8.14.

6.3.8.15 In approximately 200 seconds, VERB 06 NOUN 66 shall flash.
Read and record from CRT DSKY Row (-X IRIG Scale Factor error in parts per million, Position -00001).

6.3.8.16 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
-00002 ENTR

NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM lamp is ON, enter VERB 36 ENTR and repeat steps 6.3.8.3 through 6.3.8.7 and 6.3.8.16.

6.3.8.17 In approximately 200 seconds, VERB 06 NOUN 66 shall flash.
Read and record from CRT DSKY Row 1 (+Y IRIG Scale Factor error in parts per million, Position -00002).

6.3.8.18 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
-00003 ENTR

NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM is ON, enter VERB 36 ENTR and repeat steps, 6.3.8.3 through 6.3.8.7 and 6.3.8.18.

6.3.8.19 In approximately 200 seconds, VERB 06 NOUN 66 shall flash.
Read and record from CRT DSKY Row 1 (*Z IRIG Scale Factor error in parts per million,
Position -00003).

6.3.8.20 Repeat steps 6.3.8.8 through 6.3.8.19 twice to obtain second and third set of
data.

6.3.8.21 Terminate this test by entering in K-148 the following:

VERB 34 ENTR
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR

6.3.8.22 The average of the three readings of Scale Factor Error for each of the 6
positions shall be 0 ± 1750 PPM.

6.3.9 IMU Performance Test. A reference data sheet is provided at the end of this
section to aid in data reduction.

6.3.9.1 Insure that IMU Operate power and LGC Operate power has been applied for a
minimum of one hour and that the IMU is not in a Gimbal Lock condition.

6.3.9.2 On CRT display, monitor and record IRIG TEMP (GG2301) and PIPA TEMP (GG2300).

6.3.9.3 Adjust oscilloscope to display butterfly of X PIPA.

6.3.9.4 On K-148 enter the following:

VERB 01 NOUN 10 ENTR
00003 ENTR
Record CRT DSKY Row 1 indication AAAAA and the time of day.

6.3.9.5 On K-148 enter the following:

VERB 21 NOUN 01 ENTR
01300 ENTR
AAAAA ENTR
VERB 06 NOUN 62 ENTR
01300 ENTR
Record CRT DSKY Row 1 indications as +BBBBB.

6.3.9.6 Perform the following calculations:

- a. $\frac{BBBBB \times 5.12}{3600} = CCCC.C$ (Contents (hrs) of high order scalar register)
- b. 23.3 - CCCC.C = DDDD.D hours.
- c. DDDD.D + present time of day = time of day at which high order scalar register will overflow.

6.3.9.7 If the time of day is within 12 minutes of that calculated in 6.3.9.6.c when about to perform any of the following paragraphs, wait until that time calculated in 6.3.9.6.c has passed and proceed.

Paragraph

6.3.9.15
6.3.9.23
6.3.9.30
6.3.9.36
6.3.9.43
6.3.9.48

6.3.9.8 On K-148 enter the following sequence:

VERB 01 NOUN 01 ENTR
00370 ENTR
Record contents of CRT DSKY Row 1 XXXXY
VERB 21 NOUN 01 ENTR
00370 ENTR
XXXXY' ENTR
Where Y' is obtained from Table 1a.
VERB 57 ENTR
00001 ENTR
VERB 06 NOUN 61 shall flash

6.3.9.9 On the CRT, DSKY display verify R1 (Navigation Base Azimuth) and R2 (Site Latitude) are correct.

6.3.9.10 If values for R1 and R2 are correct, proceed to next step.

If values for R1 and R2 are incorrect, enter the following sequence into K-148.

VERB 24 ENTR
+XXX.XX ENTR (Correct navigation base azimuth ± 0.50 deg)
+40.748 ENTR (Correct site latitude)
Verify values in R1 and R2 are correct.

6.3.9.11 On K-148 enter the following sequence:

VERB 33 ENTR
VERB 06 NOUN 66 shall flash

6.3.9.12 On CRT, DISKY display, verify R1 = +00000 (Time),
R2 = +00000 (Test Index No.) and R3 = +00001 (Test Position).
If values for R1, R2 and R3 are correct, proceed to next step.
If values for R1, R2 and R3 are incorrect, enter the following sequence
into K-148:

VERB 25 ENTR
+00000 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00001 ENTR (Test Position Entry)

6.3.9.13 On K-148 enter the following sequence:

VERB 25 ENTR

6.3.9.14 In approximately 12 minutes, VERB 06 NOUN 06 shall flash. From the CRT, DSKY display, record R2 (+NBDY Position +00001).

6.3.9.15 On K-148 enter the following sequence:

VERB 33 ENTR

6.3.9.16 Deleted.

6.3.9.17 In approximately 5 minutes, VERB 06 NOUN 06 shall flash. From the CRT, record R1 and R2 (+X PIPA Position +00001). Row 1 is whole part, Row 2 is fractional part. Units are cm/sec^2 .

6.3.9.18 On K-148 enter the following sequence:

VERB 34 ENTR

VERB 06 NOUN 06 shall flash

6.3.9.19 On CRT, DSKY display - verify R1 = +00600, R2 = +00000, and R3 = +00002.

6.3.9.20 On K-148 enter the following sequence:

VERB 33 ENTR

6.3.9.21 In approximately 12 minutes VERB 06 NOUN 06 shall flash. From the CRT, DSKY display record R2 (+NBDZ Position +00002).

6.3.9.22 On K-148 enter the following sequence:

VERB 33 ENTR

6.3.9.23 Approximately 5 minutes VERB 06 NOUN 06 shall flash. From the CRT, record R1 and R2 (-X PIPA Position +00002).

6.3.9.24 On K-148 enter the following sequence:

VERB 28 ENTR

Record CRT GDU gimbal angle indications and time.

6.3.9.25 In approximately 67 minutes, VERB 06 NOUN 06 shall flash. From the CRT, DSKY display record R2 (+NBDX + ADIAX Pos +00002). Record CRT GDU gimbal angle indications and time.

6.3.9.26 On K-148 enter the following sequence:

VERB 34 ENTR

VERB 06 NOUN 06 shall flash

6.3.9.27 On CRT, DSKY display, verify R1 = +00600, R2 = +00000, and R3 = +00003.

6.3.9.28 On K-148 enter the following sequence:

VERB 33 ENTR

6.3.9.29 In approximately 12 minutes VERB 06 NOUN 66 shall flash. From the CRT, DSKY display record R2 (-NBDX Position +00003).

6.3.9.30 On K-148 enter the following sequence:

VERB 33 ENTR

6.3.9.31 In approximately 5 minutes, VERB 06 NOUN 66 shall flash. From the CRT, DSKY display record R1 and R2 (+Z PIPA Position +00003).

6.3.9.32 On K-148 enter the following sequence:

VERB 34 ENTR

VERB 06 NOUN 66 shall flash

6.3.9.33 On the CRT, DSKY display verify R1 = +00600, R2 = 00000, and R3 = +00004.

6.3.9.34 On K-148 enter the following sequence:

VERB 33 ENTR

6.3.9.35 In approximately 12 minutes, VERB 06 NOUN 66 shall flash. From the CRT, DSKY display record R2 (+NBDY + ADSRAY Position +00004).

6.3.9.36 On K-148 enter the following sequence:

VERB 33 ENTR

6.3.9.37 Deleted.

6.3.9.38 In approximately 5 minutes, VERB 06 NOUN 66 shall flash. From the CRT, DSKY display record R1 and R2 (-Z PIPA Position +00004).

6.3.9.39 On K-148 enter the following sequence:

VERB 33 ENTR

Record CRT DSKY global angle indications and time.

6.3.9.40 In approximately 67 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R2 (+NBDZ + ADIAZ Position +00004). Record R2 on DSKY display and transfer results to line 1.

6.3.9.41 On K-148 enter the following sequence:

VERB 33 ENTR
VERB 06 NOUN 66 shall flash

6.3.9.42 From the CRT, DSKY display verify R1 = +00600, R2 = +00000 and R3 = +00005.

6.3.9.43 Record time: On K-148 enter the following sequence:

VERB 33 ENTR

6.3.9.44 The PROG alarm and GIMBAL LOCK lamps shall light. Press Error Reset.

6.3.9.45 In approximately 5 minutes, VERB 06 NOUN 66 shall flash. From the CRT, DSKY display record R1 and R2 (+Y PIPA Position +00005). Correct measured g term per Para 6.3.9.70.1 and transfer results to line 1.

6.3.9.46 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.3.9.47 On the CRT, DSKY display verify R1 = +00600, R2 = +00000 and R3 = +00006.

6.3.9.48 Record time: On K-148 enter the following sequence:

VERB 33 ENTR

6.3.9.49 The PROG alarm and GIMBAL LOCK lamps shall light. Press Error Reset.

6.3.9.50 In approximately 5 minutes VERB 06 NOUN 66 shall flash. From the CRT, DSKY display record R1 and R2. (-Y PIPA Position +00006). Correct measured g term per Para 6.3.9.70.1 and transfer results to line 1.

6.3.9.51 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

- 6.3.9.52 On the CRT, DSKY display, verify R1 = +00600, R2 = +00000 and R3 = +00007.
6.3.9.53 On K-148 enter the following sequence:

VERB 33 ENTR

- 6.3.9.54 In approximately 12 minutes VERB 06 NOUN 66 shall flash. From the CRT, DSKY display record R2 (+.707 ADSRAX-NBDX Position +00007).

- 6.3.9.55 On K-148 enter the following sequence:

VERB 34 ENTR

VERB 06 NOUN 66 shall flash

- 6.3.9.56 On the CRT, DSKY display, verify R1 = +00600, R2 = +00000, and R3 = +00008.
6.3.9.57 On K-148 enter the following sequence:

VERB 33 ENTR

- 6.3.9.58 In approximately 12 minutes VERB 06 NOUN 66 shall flash. From the CRT, DSKY display, record R2 [-.707 (NBDZ+NBDY) +0.5 (ADIAZ - ADIAY) +0.5 (ADSRAY + ADSRAZ)] (Position + 00008).

- 6.3.9.59 On K-148 enter the following:

VERB 34 ENTR

VERB 06 NOUN 66 shall flash

- 6.3.9.60 On the CRT, DSKY display, verify R1 = +00600, R2 = +00000, and R3 = +00009.
6.3.9.61 On K-148 enter the following sequence:

VERB 33 ENTR

- 6.3.9.62 In approximately 12 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (-NBDZ + .707 ADSRAZ Position +00009).

- 6.3.9.63 On K-148 enter the following sequence:

VERB 34 ENTR

VERB 06 NOUN 66 shall flash

- 6.3.9.64 On the CRT, DSKY display, verify R1 = +00600, R2 = +00000, and R3 = +00010.
6.3.9.65 On K-148 enter the following sequence:

VERB 33 ENTR

- 6.3.9.66 In approximately 12 minutes VERB 06 NOUN 66 shall flash. From the CRT, DSKY display record R2 [.707 (NBDY-NBDX) +.5 (ADIAY - ADIAX) +.5 ADSRAX] (Position +00010).

- 6.3.9.67 Terminate this test by entering in K-148 the following:

VERB 36 ENTR

- 6.3.9.68 On CRT, record IRIG TEMP (CG 2301) and PIPA TEMP (CG 2300).

- 6.3.9.69 On K-148 enter the following sequence:

VERB 41 NOUN 20 ENTER

+00000 ENTR

+00000 ENTR

+00000 ENTR

6.3.9.70 Calculations

NOTE: Use Post Vibration or System Test data points only.

6.3.9.70.1 Y PIPA Data Correction Calculation

6.3.9.70.1.1 From the uplink file tape, the compressed data tape or the PCM tape, request a data reduction of the X and Z accelerometer ΔV counts (addresses 37 and 41, respectively) and the TIME 2 and TIME 1 registers (addresses 24 and 25, respectively) for the period during which the Y PIPA test was being performed in positions 5 and 6 of the IMU Performance test.

6.3.9.70.1.2 Perform the following calculations for position 5.

$$G_5' = \frac{G_5}{\cos \theta_{y5}}$$

where:

G_5' = Measured acceleration term (line k)

G_5 = Corrected acceleration term

$$\cos \theta_{y5} = 1 - \frac{1}{2}\theta_{y5}^2 \text{ for small angles}$$

where:

$$\theta_{y5} = \sqrt{\theta^2 x_5 + \theta^2 z_5}$$

and:

$$\theta z_5 = \frac{(\Delta V x_5 - \Delta V x \text{ Bias}) (S.F. x)}{(\Delta T) (\text{local } g)}$$

$$\theta x_5 = \frac{(\Delta V z_5 - \Delta V z \text{ Bias}) (S.F. z)}{(\Delta T) (\text{local } g)}$$

and:

$$V_x \text{ Bias} = \frac{(X \text{ PIPA Bias}) (\Delta T)}{S.F. x}$$

$$V_z \text{ Bias} = \frac{(Z \text{ PIPA Bias}) (\Delta T)}{S.F. z}$$

S.F. and Bias terms are obtained from positions 1 through 4 of the IMU Performance Test.

6.3.9.70.1.3 Perform the following calculations for position 6.

$$G'_6 = \frac{G_6}{\cos \theta_{y6}}$$

where:

G_6 = Measured acceleration term (line e)

G'_6 = Corrected acceleration term

$\cos \theta_{y6} = 1 - \frac{1}{2}\theta_{y6}^2$ for small angles

$$\theta_{y6} = \sqrt{\theta_{x6}^2 + \theta_{z6}^2}$$

and:

$$\theta_{x6} = \frac{(\Delta V_{x6} - \Delta V_x \text{ Bias}) (S.F._x)}{(\Delta T) (\text{local } g)}$$

$$\theta_{z6} = \frac{(\Delta V_{z6} - \Delta V_z \text{ Bias}) (S.F._z)}{(\Delta T) (\text{local } g)}$$

and:

$$V_x \text{ Bias} = \frac{(X \text{ PIPA Bias}) (\Delta T)}{S.F._x}$$

$$V_z \text{ Bias} = \frac{(Z \text{ PIPA Bias}) (\Delta T)}{S.F._z}$$

S.F. and Bias terms are obtained from positions 1 through 4 of the IMU Performance Test.

6.3.9.70 Calculations

NOTE: Use Post Vibration or System Test data points only.

- 6.3.9.70.2 Obtain data from last IRIG and/or PIPA test and fill in Data Sheet x_{i-1} .
- 6.3.9.70.3 Obtain data from second last IRIG and/or PIPA test and fill in Data Sheet x_{i-2} .
- 6.3.9.70.4 Obtain data from third last IRIG and/or PIPA test and fill in Data Sheet x_{i-3} .
- 6.3.9.70.5 Perform the following calculations for each item appearing on Data Sheet x_i and transfer all results to lines au through bi.

NOTE:

See paragraph 5.6 before continuing

$$D_1 = |x_{i-1} - x_i|$$

$$D_2 = |x_{i-1} - x_i| + |x_{i-2} - x_{i-1}|$$

$$D_3 = |x_{i-3} - x_{i-2}| + |x_{i-2} - x_{i-1}| + |x_{i-1} - x_i|$$

6.3.10 LGC Voltage Margin Test

6.3.10.1 Initial Conditions

6.3.10.1.1 Insure that the G&N System is in the Standby Mode.

6.3.10.1.2 On the CRT, verify the +28 VDC LGC OPERATE bus is between 24.5 and 33.5 vdc (GG 1520).

6.3.10.1.3 Rotate the ANUN/NUM dimmer control for minimum readable EL brightness. Insure that the ANNUN OVERRIDE switch is OFF.

6.3.10.2 Voltage Margin Determination

6.3.10.2.1 On the PSA Adapter Module (PSAAM) (410-31080), place INHIBIT VOLTAGE FAIL switch to ON.

CAUTION: The +4 vdc LGC Supply voltage shall never be operated lower than +2.5 vdc or higher than +5.2 vdc (GG1030).

The +14 vdc LGC Supply shall never be operated less than +6.5 vdc or higher than +17.0 vdc (GG 1020). LTG-ANUN/NUM Control on panel 5 shall be set to DIM during the performance of the Voltage Margin Test in order to avoid decreasing the operating life of the ~~DISK~~ EL lamps; indication of the LGC supplies may be disregarded for this test. The charts in Table II may be used to determine approximate values for "XX, X" values.

NOTE: That flashing indication of the LGC supplies may be disregarded for this test. The charts in Table II may be used to determine approximate values for "XX, X" values of C-156 voltage dial settings corresponding to various power supply voltages.

DATA SHEET

ITEM NO.	PARAMETER	UNITS	RECORDED VALUE	
6.3.9.14	+N BDY Position +00001 Transfer result to line af	meru	() ---. --	a.
6.3.9.17	+X PIPA Test Position +00001	cm/sec ²	() 00---. () ---	b.
6.3.9.21	+N BDZ Position +00002 Transfer result to line ag	meru	() ---. --	c.
6.3.9.23	-X PIPA Test Position +00002	cm/sec ²	() 00---. () ---	d.
6.3.9.25	-N BDY + ADIAX Position +00002	meru	() ---. --	e.
6.3.9.29	-N BDY Position +00003 Multiply by -1 and transfer result to line ah	meru	() ---. --	f.
6.3.9.31	+Z PIPA Test Position +00003	cm/sec ²	() 00---. () ---	g.
6.3.9.35	+N BDY + ADGRAY Position +00004	meru	() ---. --	h.
6.3.9.38	-Z PIPA Test Position +00004	cm/sec ²	() 00---. () ---	i.
6.3.9.40	+N BDZ + ADIAZ Position +00004	meru	() ---. --	j.
6.3.9.45	+Y PIPA Test Position +00005	cm/sec ²	() 00---. () ---	k.
6.3.9.50	-Y PIPA Test Position +00006	cm/sec ²	() 00---. () ---	l.

DATA SHEET

ITEM NO.	PARAMETER	UNITS	RECORDED VALUE
6.3.9.54	-NBDX+.707 ADSRAX Position +00007	meru	
6.3.9.58	-.707 (NBDZ+NBDY) +.5 (ADIAZ-ADIAV) +.5 (ADSRAY+ADSRAX) Position +00008	meru	
6.3.9.62	-NBDZ+.707ADSRAX Position +00009	meru	
6.3.9.66	.707(NBDY-NBDX) +.5 (ADIAV-ADIAZ) +.5 ADSRAX Position +00010	meru	

m.

n.

o.

p.

DATA SHEET

CALCULATION	PARAMETER	UNITS	
line c - line f = () ---. -- (-NBDX+ADIAX) - (-NBDX) Transfer result to line al.	ADIAX	meru/g	q
line h - line a = () ---. -- (-NBDY+ADSRAY) - (-NBDY) Transfer result to al.	ADSRAY	meru/g	r
line j - line c = () ---. -- (-NBDZ+ADIAZ) - (-NBDZ) Transfer result to line am.	ADIAZ	meru/g	s
(line m - line f) X 1.414 = () ---. -- [(-NBDX + .707 ADSRAX) - (-NBDX)] X 1.414 Transfer result to line ak.	ADSRAX	meru/g	t
(line o + line c) X 1.414 = () ---. -- (-NBDZ + .707 ADSRAZ + NBDZ) X 1.414 Transfer result to line al.	ADSRAX	meru/g	u
(line p - .707 line a - .707 line f + .5 line q - .5 line t) X2 = ---. -- [.707 (NBDY-NBDX) + .5 (ADIAZ-ADIAX) + .5 ADSRAX -.707 (-NBDX) -.707 NBDY + .5 ADIAZ -.5 ADSRAX] X2 Transfer result to line an.	ADIAZ	meru/g	v
line b - line d = () ---. --	PIPA X2G	cm/sec ²	w
line k - line l = () ---. --	PIPA Y2G	cm/sec ²	x
line g - line i = () ---. --	PIPA Z2G	cm/sec ²	y
1960.52 ÷ line w x 1 cm/sec/pulse = Subtract 1.000000 from this value, multiply x 10 ⁶ and transfer results to line ao.	X PIPA S. F.	cm/sec/ pulse	z
1960.52 ÷ line x X 1 cm/sec/pulse = Subtract 1.000000 from this value, multiply x 10 ⁶ and transfer results to line ap.	Y PIPA S. F.	cm/sec/ pulse	aa
1960.52 ÷ line y X 1 cm/sec/pulse = Subtract 1.000000 from this value, multiply x 10 ⁶ and transfer results to line ao.	Z PIPA S. F.	cm/sec/ pulse	ab
1/2 (line b + line d) = () ---. -- Transfer results to line ar	X PIPA Bias	cm/sec ²	ac
1/2 (line k + line l) = () ---. -- Transfer results to line as	Y PIPA Bias	cm/sec ²	ad
1/2 (line g + line i) = () ---. -- Transfer results to line at	Z PIPA Bias	cm/sec ²	ae

TABLE I

Y	Y'
0	2
1	3
2	2
3	3
4	6
5	7
6	6
7	7

DATA SHEET
(24)

PARAMETER	UNITS	MIN VALUE	RECORDED VALUE	MAX VALUE	REJ	ACC
NBDY	meru	-15		+15		
NBDZ	meru	-15		+15		
NBCX	meru	-15		+15		
ADSRAY	meru/g	-40		+40		
ADSRZ	meru/g	-40		+40		
ADSRAX	meru/g	-40		+40		
ADIAZ	meru/g	-100		+100		
ADIAZ	meru/g	-100		+100		
ADLAY	meru/g	-100		+100		
X PIPA S. F. error from line z	PPM	-1900		+1900		
Y PIPA S. F. error from line as	PPM	-1900		+1900		
Z PIPA S. F. error from line ab	PPM	-1900		+1900		
X PIPA Bias from line ac	cm/sec ²	-3.1		+3.1		
Y PIPA Bias from line ad	cm/sec ²	-3.1		+3.1		
Z PIPA Bias from line ae	cm/sec ²	-3.1		+3.1		

af
ag
ah
ai
aj
ah
al
am
an
ao
ap
aq
ar
as
at

DATA SHEET
(Xt-1)

PARAMETER	UNITS	RECORDED VALUE
NBDY	meru	
NBDZ	meru	
NBDX	meru	
ADSRAY	meru/g	
ADSRZ	meru/g	
ADSRAX	meru/g	
ADLAX	meru/g	
ADLXZ	meru/g	
ADLAY	meru/g	
X PIPA S. F. error	PPM	
Y PIPA S. F. error	PPM	
Z PIPA S. F. error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

DATA SHEET
(x1-2)

PARAMETER	UNITS	RECORDED VALUE
NBDY	meru	
NBDZ	meru	
NBDX	meru	
ADSRAY	meru/g	
ADSRZ	meru/g	
ADSRAX	meru/g	
ADLAX	meru/g	
ADLAZ	meru/g	
ADLAY	meru/g	
X PIPA S. F. error	PPM	
Y PIPA S. F. error	PPM	
Z PIPA S. F. error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

DATA SHEET
(x1-3)

PARAMETER	UNITS	RECORDED VALUE
NBDY	meru	
NBDZ	meru	
NBDX	meru	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADSRAX	meru/g	
ADIAX	meru/g	
ADIAZ	meru/g	
ADIAZ	meru/g	
X PIPA S. F. error	PPM	
Y PIPA S. F. error	PPM	
Z PIPA S. F. error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

DATA SHEET

PARAMETER	UNITS	D ₁	MAX	D ₂	MAX	D ₃	MAX	
NBDY	meru		6		9		11	au
NBDZ	meru		6		9		11	av
NEDX	meru		6		9		11	aw
ADSRAY	meru/g		14		21		25	ax
ADSRAZ	meru/g		14		21		25	ay
ADSRAX	meru/g		14		21		25	az
ADIAX	meru/g		17		33		40	ba
ADIAZ	meru/g		17		33		40	bb
ADIA Y	meru/g		17		33		40	bc
X PIPA S. F.	Error PPM		400		500		600	bd
Y PIPA S. F.	Error PPM		400		500		600	be
Z PIPA S. F.	Error PPM		400		500		600	bf
X PIPA Bias	cm/sec ²		0.5		0.7		0.9	bg
Y PIPA Bias	cm/sec ²		0.5		0.7		0.9	bh
Z PIPA Bias	cm/sec ²		0.5		0.7		0.9	bi

6.3.10.2.2 Enter 0001 into R155. Verify and execute.

6.3.10.2.3 Enter 1111 into R154. Verify and execute.

6.3.10.2.4 Enter in C-156 $\pm XX.X001114$. (Enter a value for XX.X which will adjust the +14V power supply (GG 1020) as monitored on the CRT, to 12.2 (+0.3, -0) vdc. See Table II). Execute.

6.3.10.2.5 Enter in C-156 $\pm XX.X001124$ (Enter a value for XX.X which will adjust the +4V power supply (GG 1030) as monitored on the CRT, to 3.5 (+0.15, -0) vdc. See Table II). Execute.

6.3.10.2.6 On K-148 press ERROR RESET.

6.3.10.2.7 On K-148 initiate LGC Self-Check by entering the following:

VERB 21 NOUN 27 ENTR
77767 ENTR

Wait 200 seconds. Verify RESTART lamp on the DSKY is not lit.

6.3.10.2.7.1 Into R154 insert 0011. Verify and execute.

6.3.10.2.8 On the PSA Adapter Module place INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on the DSKY is lighted.

6.3.10.2.9 On the PSA Adapter Module place INHIBIT VOLTAGE FAIL switch to ON. Into R-154 insert 1111. Verify and execute. Press ERROR RESET. Perform the following DSKY operations.

VERB 21 NOUN 27 ENTR
77767 ENTR

6.3.10.2.10 Enter in C-156 $(\pm) XX.X001114$ (Enter a value for XX.X which will adjust the +14V power supply (GG 1020) as monitored on the CRT, to 16.4 (+0, -0.4) vdc. See Table II). Execute.

6.3.10.2.11 On K-148 press ERROR RESET. Wait 200 seconds. Verify RESTART lamp on DSKY is not lighted.

6.3.10.2.11.1 Into R154 insert 1100. Verify and execute.

6.3.10.2.12 On the PSA Adapter Module place INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on the DSKY is lighted. Set the INHIBIT VOLTAGE FAIL switch to ON. Into R-154 insert 1111. Verify and execute. Press ERROR RESET. Perform the following DSKY operations.

VERB 21 NOUN 27 ENTR
77767 ENTR

6.3.10.2.13 Enter in C-156 ~~XX~~.X001124 (Enter a value for XX.X which will adjust the 4V power supply (GG 1030) as monitored on the CRT, to 4.6 (+0, -0.2) vdc. See Table II). Execute.

6.3.10.2.14 On K-148 press ERROR RESET. Wait 200 seconds. Verify RESTART lamp on DSKY is not lit.

6.3.10.2.14.1 Into R154 insert 0011. Verify and execute.

6.3.10.2.15 On the PSA Adapter Module place INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on the DSKY is lit. Set the INHIBIT VOLTAGE FAIL switch to ON. Into R-154, insert 1111. Verify and execute. Press ERROR RESET. Perform the following DSKY operations:

VERB 21 NOUN 27 ENTR
77767 ENTR

6.3.10.2.16 Enter in C-156 (4) XX.X001114 (Enter a value for XX.X which will adjust the 14V power supply (GG 1020) as monitored on the CRT, to 12.2 (+0.3, -0) vdc. See Table II). Execute.

6.3.10.2.17 On K-148 press ERROR RESET. Wait 200 seconds. Verify RESTART lamp on DSKY is not lighted.

6.3.10.2.17.1 Into R154 insert 1100. Verify and execute.

6.3.10.2.18 On the PSA Adapter Module place INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on the DSKY is lighted.

6.3.10.2.19 On R-154 enter 0000. Execute.

6.3.10.2.20 On R-155 enter 0000. Execute.

6.3.10.2.21 On K-148 terminate the LGC Self-Check by entering the following:

VERB 21 NOUN 27 ENTR
00000 ENTR

6.3.10.2.22 On K-148 press ERROR RESET.

6.3.11 LGC Clock Frequency Test

6.3.11.1 Insure that LGC Operate power has been applied for a minimum of 10 minutes before performing this test.

6.3.11.2 Verify that the counter is connected to the 3.2kc signal on the hardline.

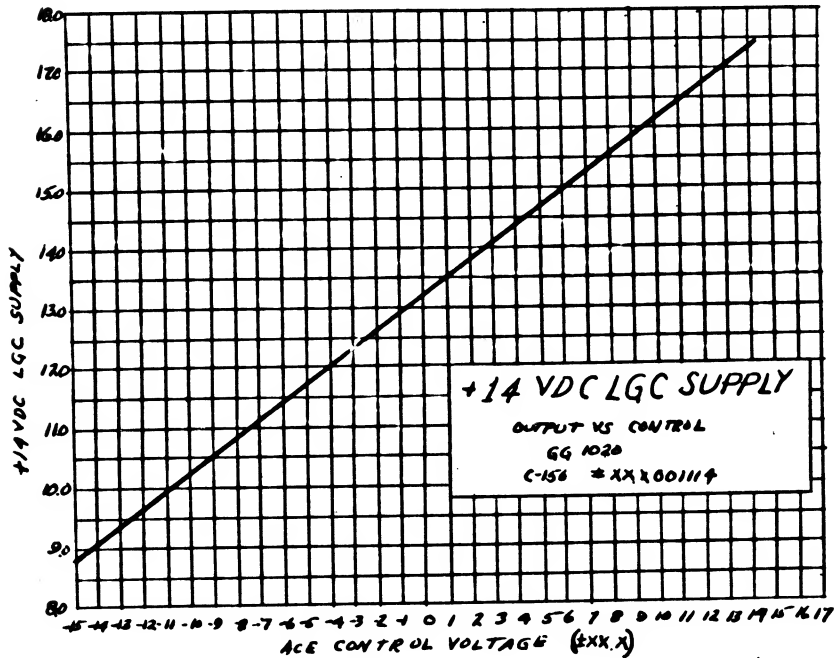
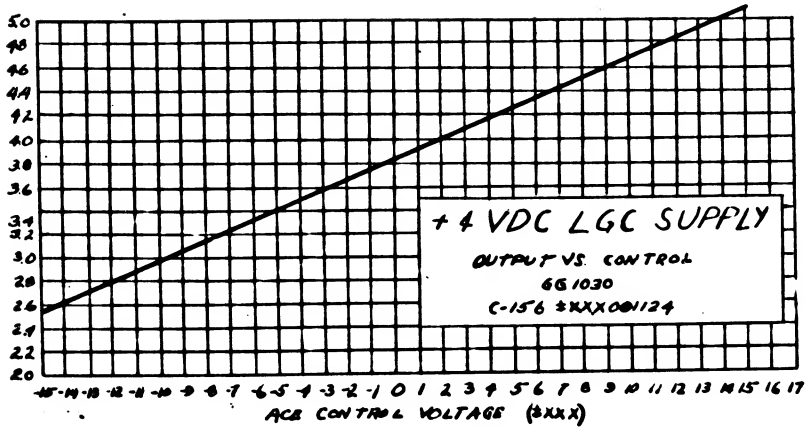


TABLE II

6.3.11.3 Insure that the counter has been warming up for a minimum of 30 minutes.

6.3.11.4 On the counter,

Set the FUNCTION switch to: MAN START

Set the TIME BASE switch to: 1 μ s TIME UNIT/COUNT

Set the SENSITIVITY control to: CHECK

6.3.11.5 Verify proper counter operation.

6.3.11.6 Set the FUNCTION switch to REMOTE OR TIME INTERVAL.

6.3.11.7 Plug in the Preset unit and set:

MODE switch to PRESET

N switches to 96000

6.3.11.8 Turn SAMPLE RATE control fully clockwise (HOLD). Wait 35 seconds for counter display to fill.

6.3.11.9 Start counting by depressing RESET switch on counter.

6.3.11.10 After approximately 30 seconds, read and record counter display.

6.3.11.11 Repeat steps 6.3.11.9 and 6.3.11.10. 9 times.

6.3.11.12 The average of the 10 previous readings shall be 30.000000 \pm 0.000060 seconds.

6.3.11.13 Insure that the System is not in IMU Operate.

6.3.11.14 Enter the following on K-146 operations.

VERB 00	ENTER
00013	Press and hold the PEO pushbutton on the DSKY for 3
02000	seconds. Verify the STANDBY lamp is lighted.
	ENTER

6.3.11.15 Repeat steps 6.3.11.9 through 6.3.11.12.
Press and hold the PEO pushbutton on the DSKY for 3 seconds. Verify the Standby lamp is lighted.

6.3.11.16 Press and hold the PRO pushbutton on the DSKY for 3 seconds. Verify the STANDBY lamp is not lighted. If the STANDBY light remains lit, depress the PRO pushbutton for a maximum of two additional times. RESTART lamp may come on. Enter VERB 01 ENTR on K-148.

6.3.11.17 On the Computer Control and Reticle dimmer assembly, press and hold MARK X pushbutton.

6.3.11.18 On the DSKY observe

VERB 05 NOUN 31
Row 1 = 00112
Prog Alarm lamp is lighted
Press Error Reset

6.3.11.19 Enter the following on K-148

VERB 11 NOUN 10 ENTR
00016 ENTR

6.3.11.20 Observe that DSKY Row 1 displays 00004.

6.3.11.21 Release MARK X pushbutton

6.3.11.22 Observe that DSKY Row 1 displays 00000.

6.3.11.23 Press and hold the MARK Y pushbutton on the Computer Control and Reticle Dimmer Assembly.

6.3.11.23.1 On the DSKY Observe

VERB 05 NOUN 31
Row 1 = 00112
Program Alarm lamp is lighted
Press ERR Reset

6.3.11.23.2 Enter the following on K-148:

VERB 11 NOUN 10 ENTR
00016 ENTR

6.3.11.24 Observe that DSKY Row 1 displays 00010.

6.3.11.25 Release MARK Y pushbutton

6.3.11.26 Observe that DSKY Row 1 displays 00000.

6.3.11.27 Press and hold the REJECT pushbutton on the Computer Control and Reticle Dimmer Assembly.

6.3.11.27.1 On the DSKY observe

VERB 05 NOUN 31
Row 1 = 00112
Prog alarm lamp is lighted
Press ERR Reset

6.3.11.27.2 Enter the following on K-148:

VERB 11 NOUN 10 ENTR
00016 ENTR

6.3.11.28 Observe that DSKY Row 1 displays 00020.

6.3.11.29 Release the REJECT pushbutton.

6.3.11.30 Observe that DSKY Row 1 displays 00000.

6.3.11.31 On the DSKY perform the following operation

VERB 36 ENTR

6.3.11.32 On panel 11 close PGNS AOT lamp circuit breaker. On the Computer Control and Reticle dimmer assembly, rotate the RETICLE BRIGHTNESS control to its minimum light intensity position. View through the AOT and verify that the reticle lamp is off.

6.3.11.33 While viewing through the AOT, slowly rotate the RETICLE BRIGHTNESS control to increase the reticle brightness until a stop is reached. Observe that the reticle brightness has increased in intensity. Return RETICLE BRIGHTNESS control to off state. On panel 11 open PGNS AOT lamp circuit breaker.

6.3.11.34 AOT eyepiece Heater Test.

6.3.11.34.1 Secure milliammeter HP 428B and current probe HP428A-21A.

6.3.11.34.2 Locate P1 at Computer Control and Reticle Dimmer assembly. Push lacing cord away from P1 back to fifth tie point.

6.3.11.34.3 Clip current probe HP428A-21A to blue wire in cable with red arrow pointing away from P1. Measure and record current indication. The current shall be between 139 and 244 ma.

6.3.11.34.4 Remove current probe, push lacing cord back to P1 and spot tie.

6.3.12 Gimbal Friction Test

6.3.12.1 Inner Gimbal Friction Test

6.3.12.1.1 On K-148 enter the following sequence:

VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+17000 ENTR
+17000 ENTR
+17000 TROUBLE ENTR
Wait 15 seconds

VERB 41 NOUN 20 ENTR
+27000 ENTR
+27000 ENTR
+27000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR

6.3.12.1.2 On the CRT, verify CDU X, CDU Y, CDU Z indicate +00000 (+00200).

6.3.12.1.3 Set up Analog Recorder to monitor the following signals:

MEAS. NO.	SIGNAL NAME
a. GG2110	IG Torque Motor Current
b. GG2106	IG Servo Error Total
c. GG2107	IG Servo Error in Phase
d. GG2112	IG 1x Resolver Sine
e. GG2113	IG 1x Resolver Cosine
f. GG2230	IG CDU Fine Error
g. GG1201	IMU 28V 1% 800 CPS
h. GG2221	IG CDU Coarse Error

6.3.12.1.4 Set up Analog Recorder to monitor the following signals:

MEAS NO.	SIGNAL NAME
a. GG2300	PIPA TEMP
b. GG2301	IRIG TEMP
c. GG1520	+28 VDC LGC OPR BUS

6.3.12.1.5 After 10 seconds has elapsed since step 6.3.12.1.1, enter the following into K-148.

VERB 21 NOUN 01 ENTR
00403 ENTR
00000 ENTR

6.3.12.1.6 Verify on CRT, DSKY display

VERB 21 NOUN 01
R1 = 00000
R3 = 00403

6.3.12.1.7 On K-148 enter the following sequence:

NOUN 15 ENTR
00000 ENTR ENTR
37777 ENTR ENTR
37743 ENTR ENTR
00000 ENTR ENTR
00000 ENTR (once)

6.3.12.1.8 IG - 360° TORQUE

6.3.12.1.9 On K-148 enter the following sequence:

VERB 01 NOUN 01 ENTR
00370 ENTR
Record contents of CRT DSKY Row 1 xxxxY
VERB 21 NOUN 01 ENTR
00370 ENTR
XXXXY' ENTR
Where Y' is obtained from Table 1
VERB 42 ENTR
VERB 33 ENTR

6.3.12.1.10 Monitor analog recorder. When the IG Torque Motor Current signal (GG2110) drops to a quiescent level (approximately 12 minutes), stop the recorders.

6.3.12.1.11 On K-148 enter the following sequence:

VERB 40 NOUN 20 ENTR
Wait 3 seconds
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+17000 ENTR
+17000 ENTR
+17000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+27000 ENTR
+27000 ENTR
+27000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR

6.3.12.1.12 On the CRT, verify CDU X, CDU Y, CDU Z all indicate +00000 (+00200).

6.3.12.1.13 After 10 seconds has elapsed since step 6.3.12.1.11 enter the following sequence into K-148:

VERB 21 NOUN 01 ENTR
00403 ENTR
00000 ENTR

6.3.12.1.14 Verify on CRT, DSKY display

VERB 21 NOUN 01
R1 00000
R3 00403

6.3.12.1.15 On K-148 enter the following sequence:

NOUN 15 ENTR
00000 ENTR ENTR
40000 ENTR ENTR
40034 ENTR ENTR
00000 ENTR ENTR
00000 ENTR (once)

6.3.12.1.16 IG + 360° TORQUE

6.3.12.1.17 On K-148 enter the following sequence

VERB 42 ENTR
VERB 33 ENTR

6.3.12.1.18 Monitor analog recorder. When the IG Torque Motor Current signal (GG2110) drops to a quiescent level (approximately 12 minutes), stop the recorders.

6.3.12.2 Outer Gimbal Friction Test

6.3.12.2.1 On K-148 enter the following sequence:

VERB 40 NOUN 20 ENTR
Wait 3 seconds
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+17000 ENTR
+17000 ENTR
+17000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+27000 ENTR
+27000 ENTR
+27000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR

APOLLO G&N Specification
ND1002323 REV J

6.3.12.2.2 On the CRT, verify CDU X, CDU Y, CDU Z indicate +00000 (± 00200).

6.3.12.2.3 Set up analog recorder to monitor the following:

MEAS NO.	SIGNAL NAME
a. GG2167	OG Servo Error In Phase
b. GG2170	OG Torque Motor Current
c. GG2166	OG Servo Error Total
d. GG2260	OG CDU Fine Error
e. GG2172	OG 1x Resolver Sine
f. GG2173	OG 1x Resolver Cosine
g. GG2261	OG CDU Coarse Error

6.3.12.2.4 After 10 seconds has elapsed since step 6.3.12.2.1 enter the following sequence into K-148:

VERB 21	NOUN 01	ENTR
00403	ENTR	
37777	ENTR	

6.3.12.2.5 Verify on CRT, DSKY display

VERB 21	NOUN 01
R1	37777
R3	00403

6.3.12.2.6 On K-148 enter the following sequence:

NOUN 26	ENTR	
37743	ENTR	ENTR
00000	ENTR	ENTR
00000	ENTR	ENTR
00000	ENTR	ENTR
00000	ENTR	(once)

6.3.12.2.7 OG - 300 TORQUE has a bar chart speed of 10 mm/sec. (OG - 300 TORQUE)

6.3.12.2.8 On K-148 enter the following sequence:

VERB 42	ENTR
VERB 33	ENTR

6.3.12.2.9 Monitor analog recorder. When the OG Torque Motor Current signal (OG2170) drops to a quiescent level (approximately 12 minutes) stop the recorders.

6.3.12.2.10 On K-148 enter the following sequence:

VERB 40 NOUN 20	ENTR
Wait 3 seconds	
VERB 41 NOUN 20	ENTR
+00000	ENTR
+00000	ENTR
+00000	ENTR
Wait 15 seconds	
VERB 41 NOUN 20	ENTR
+17000	ENTR
+17000	ENTR
+17000	ENTR
Wait 15 seconds	
VERB 41 NOUN 20	ENTR
+27000	ENTR
+27000	ENTR
+27000	ENTR
Wait 15 seconds	
VERB 41 NOUN 20	ENTR
+00000	ENTR
+00000	ENTR
+00000	ENTR

6.3.12.2.11 On the CRT, verify CDU X, CDU Y, CDU Z indicate +00000 (+00200).

6.3.12.2.12 After 10 seconds has elapsed since step 6.3.12.2.10, enter the following sequence into K-148.

VERB 21 NOUN 01	ENTR
00403	ENTR
40000	ENTR

6.3.12.2.13 Verify on CRT, DSKY display.

VERB 21 NOUN 01	
R1	40000
R3	00403

6.3.12.2.14 On K-148 enter the following sequence:

NOUN 15	ENTR	
40034	ENTR	ENTR
00000	ENTR	ENTR
00000	ENTR	ENTR
00000	ENTR	ENTR
00000	ENTR	ENTR

6.3.12.2.15 OG +360° TORQUE

6.3.12.2.16 On K-148 enter the following sequence

VERB 43	ENTR
VERB 33	ENTR

6.3.12.2.17 Monitor analog recorder. When the OG Torque Motor Current signal (GG2170) drops to a quiescent level (approximately 12 minutes) stop the recorders.

6.3.12.3 Middle Gimbals Friction Test

6.3.12.3.1 On K-148 enter the following sequence:

VERB 40	NOUN 20	ENTR
Wait 3 seconds		
VERB 41	NOUN 20	ENTR
+00000		ENTR
+00000		ENTR
+00000		ENTR
Wait 15 seconds		
VERB 41	NOUN 20	ENTR
+17000		ENTR
+17000		ENTR
+17000		ENTR
Wait 15 seconds		
VERB 41	NOUN 20	ENTR
+27000		ENTR
+27000		ENTR
+27000		ENTR
Wait 15 seconds		
VERB 41	NOUN 20	ENTR
+00000		ENTR
+00000		ENTR
+00000		ENTR
Wait 15 seconds		
VERB 41	NOUN 20	ENTR
+00000		ENTR
+00000		ENTR
+06750		ENTR

6.3.12.3.2 On the CRT, verify CDU X = +00000±00200, CDU Y = +00000±00200, and CDU Z = +06750±00200.

6.3.12.3.3 Set up analog recorder to monitor the following:

MEAS. NO.	SIGNAL NAME
a. GG2136	MG Servo Error Total
b. GG2137	MG Servo Error In Phase
c. GG2140	MG Torque Motor Current
d. GG2143	MG 1x Resolver Cosine
e. GG2250	MG CDU Fine Error
f. GG2142	MG 1x Resolver Sine
g. GG2251	MG CDU Coarse Error

6.3.12.3.4 After 10 seconds have elapsed since step 6.3.12.3.1, enter the following sequence into K-148:

```

VERB 21 NOUN 01 ENTR
00403      ENTR
00000      ENTR
  
```

6.3.12.3.5 Verify on CRT, DSKY display

```

VERB 21 NOUN 01
R1 =    0000
R3 =    00403
  
```

6.3.12.3.6 On K-148 enter the following sequence:

```

NOUN 15      ENTR
00000      ENTR ENTR
00000      ENTR ENTR
00000      ENTR ENTR
14000      ENTR ENTR
00000      ENTR (once)
  
```

6.3.12.3.7 MG - 135° TORQUE

6.3.12.3.8 On K-148 enter the following sequence:

```

VERB 42      ENTR
VERB 33      ENTR
  
```

6.3.12.3.9 Monitor analog recorder. When MG Torque Motor Current (GG2140) drops to a quiescent level (approximately 6 minutes), stop the recorders.

6.3.12.3.10 On K-148 enter the following sequence:

VERB 40 NOUN 20 ENTR
Wait 3 seconds
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+17000 ENTR
+17000 ENTR
+17000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+27000 ENTR
+27000 ENTR
+27000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
-06750 ENTR

6.3.12.3.11 On the CRT, verify CDU X = +00000+00200, CDU Y = +00000+00200, and
CDU Z = -06750+00200.

6.3.12.3.12 After 10 seconds has elapsed since step 6.3.12.3.10, enter the following sequence into K-148.

VERB 21	NOUN 01	ENTR
00403	ENTR	
00000	ENTR	

6.3.12.3.13 On the CRT, DSKY display verify:

VERB 21	NOUN 01
R1 =	00000
R3 =	00403

6.3.12.3.14 On K-148 enter the following sequence:

NOUN 15	ENTR	
00000	ENTR	ENTR
00000	ENTR	ENTR
00000	ENTR	ENTR
63777	ENTR	ENTR
77777	ENTR	(once)

6.3.12.3.15 MG+135 TORQUE is using a char. speed of 10 mm/sec. (MG+135 TORQUE)

6.3.12.3.16 On K-148 enter the following sequence:

VERB 42	ENTR
VERB 33	ENTR

6.3.12.3.17 Monitor analog recorder. When the MG Torque Motor Current signal (GG2140) drops to a quiescent level (approximately 6 minutes) stop the recorders.

6.3.12.3.18 On K-148 enter the following sequence:

VERB 41	NOUN 20	ENTR
+00000	ENTR	
+00000	ENTR	
+00000	ENTR	

6.3.12.4 Test Analysis

6.3.12.4.1 Remove the strip charts from analog recorders

6.3.12.4.2 Examine each trace carefully to detect any sharp discontinuities of the traces. Disregard all transients less than 0.5 second (5 mm) on any Torque Motor Current signal.

6.3.12.4.3 No Torque Motor Current signal on (GG2140, GG2170, GG2110) shall ever exceed (0.125) amp. Sensitivity on recorder is 20 ma/division for GG2110, GG2140 and 36 ma/division for GG2170.

6.3.12.4.4 Each CDU Fine Error (GG2220, GG2230, GG2250) shall not exceed .070 volts steady state. Disregard transients.

6.3.12.4.5 No CDU Coarse Error (GG2221, GG2281, GG2251) shall ever exceed 0.680 volts.

6.3.13 Stabilization Loop Step Response Test

6.3.13.1 M Response Test

6.3.13.1.1 On K-148 enter the following sequence:

VERB 40	NOUN 20	ENTR	Wait 3 seconds
VERB 41	NOUN 20	ENTR	
+00000	ENTR		
+00000	ENTR		
+00000	ENTR		

6.3.13.1.2 On CRT, verify IG MG, and OG gimbal angles are between 358 and 002.

6.3.13.1.3 Set up analog recorder to monitor the following:

MEAS NO.	SIGNAL NAME
a. GG2110	IG Torque Motor Current
b. GG2106	IG Servo Error Total
c. GG2107	IG Servo Error In Phase
d. GG2112	IG 1X resolver Sine
e. GG2113	IG 1X Resolver Cosine
f. GG2220	IG CDU Fine Error
g. GG1201	IMU 28V 1 PCT 800 CPS

6.3.13.1.4 On K-148 initiate FINE ALIGN by entering the following sequence:

VERB 42	ENTR
+00000	ENTR
+00000	ENTR
+00000	ENTR

6.3.13.1.5 On the CRT verify CDU X, CDU Y and CDU Z indicate +00000±00200.

CAUTION: If the transients caused by the subsequent step input do not damp out within 15 seconds, remove IMU Operate Power.

6.3.13.1.6 Enter 1000 into R-START 155.

6.3.13.1.7 Press XEQ/SEAL pushbutton on R-155 to enter the DC step voltage into the IG stabilization loop.

6.3.13.1.8 Prepare to start analog recorder at a chart speed of 100 mm/sec. (IG RESPONSE TEST)

6.3.13.1.9 Enter 0000 into R-START 155. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the IG stabilization loop.

6.3.13.1.10 After the transient on the recorder has died out, stop the recorder.

6.3.13.1.11 From the Servo Error In Phase signal recorder trace measure the time interval (T₁, Fig. 3) between the removal of the step input to the point at which the trace settles to within 5 percent of the step magnitude (A, Fig. 3). The period T₁, shall not exceed 0.1 second and the trace shall have no more than 3 overshoots.

6.3.13.2 MG Response Test

6.3.13.2.1 Set up analog recorder to monitor the following:

MEAS. NO.	SIGNAL NAME
a. GG2136	MG Servo Error Total
b. GG2137	MG Servo Error in Phase
c. GG2140	MG Torque Motor Current
d. GG2143	MG 1X Resolver Cosine
e. GG2250	MG CDU Fine Error
f. GG2142	MG 1X Resolver Sine
g. GG1201	IMU 28V 1% 800 cps

6.3.13.2.2 On the CRT, verify CDU X, CDU Y and CDU Z indicate +00000 (±00200).

CAUTION: If the transients caused by the subsequent step input do not die out within 15 seconds, remove IMU Operate power.

- 6.3.13.2.3 Enter 0100 into R-START 155. Press XEQ/SEAL pushbutton on R-155 to enter the DC step voltage into the MG stabilization loop.
- 6.3.13.2.4 Prepare to start analog recorder at a chart speed of 100 mm/sec. (MG RESPONSE TEST).
- 6.3.13.2.5 Enter 0000 into R-START 155. Start analog recorder. Press XEQ/SEAL pushbutton to remove the step input to the MG stabilization loop.
- 6.3.13.2.6 After the transient on the recorder has died out, stop the recorder.
- 6.3.13.2.7 From the Servo Error In Phase signal recorder trace measure the time interval (T1 Fig. 3) between the removal of the step input to the point at which the trace settles to within 5 percent of the step magnitude (A, Fig 3). The period, T1, shall not exceed 0.1 seconds and the trace shall have no more than 3 overshoots.

6.3.13.3 OG Response Test

- 6.3.13.3.1 Set up analog recorder to monitor the following:

MEAS. NO.	SIGNAL NAME
a. GG2167	OG Servo Error In Phase
b. GG2170	OG Torque Motor Current
c. GG2165	OG Servo Error Total
d. GG2280	OG CDU Fine Error
e. GG2172	OG 1X Resolver Sine
f. GG2173	OG 1X Resolver Cosine
g. GG1201	IMU 28V 1 $\frac{1}{2}$ 800 cps

- 6.3.13.3.2 On the CRT, verify CDU X, CDU Y and CDU Z indicate +00000 (+00200).

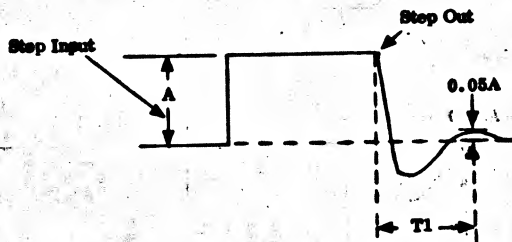
CAUTION: If the transients caused by the subsequent step input do not die out within 15 seconds, remove IMU operate power.

- 6.3.13.3.3 Enter 0010 into R-START 155. Press XEQ/SEAL pushbutton on R-155 to enter the DC step voltage into the OG stabilization loop.
- 6.3.13.3.4 Prepare to start analog recorder at a chart speed of 100 mm/sec. (OG RESPONSE TEST).
- 6.3.13.3.5 Enter 0000 into R-155. Start analog recorder. Press XEQ/SEAL pushbutton to remove the step input to the OG stabilization loop.
- 6.3.13.3.6 After the transient on the recorder has died out, stop the recorder.

6.3.13.3.7 From the Servo Error In Phase signal recorder trace, measure the time interval (T_1 , Fig 3) between the removal of the step input to the point at which the trace settles to within 5 percent of the step magnitude (A , Fig 3). The period, T_1 , shall not exceed 0.1 second and the trace shall have no more than 8 overshoots.

6.3.13.3.8 On K-148 enter the following sequence:

VERB 41	NOUN 20	ENTR
+00000	ENTR	
+00000	ENTR	
+00000	ENTR	



TYPICAL STAB LOOP RESPONSE TO STEP INPUT

FIGURE 3

6.3.14 G&N Fine Alignment Test

6.3.14.1 On K-148 enter:

VERB 01 NOUN 10 ENTR
00003 ENTR

6.3.14.2 Record CRT, DSKY Row 1 display as AAAAA and the time of day.

6.3.14.3 On K-148 enter:

VERB 21 NOUN 01 ENTR
01300 ENTR
AAAAA ENTR
VERB 06 NOUN 02 ENTR
01300 ENTR

6.3.14.4 Record CRT DSKY Row 1 display as ABBBBB

6.3.14.5 Perform the following calculations:

- a. BBBBBX 5.12 - CCCC.C Contents of high order scalar register in hours.
3600

6.3.14.5.b Calculate the times of day at which the contents of the high order scalar will be at the following times.

2.01
5.52
8.73
11.64
14.55
17.46
20.37
23.30

6.3.14.6 If the time of day is within 12 minutes of any of those times calculated in 6.3.14.5.b when about to complete step 6.3.14.30 wait until that time has passed and then proceed.

6.3.14.7 On K-148 enter:

VERB 01 NOUN 01 ENTR
00370 ENTR
Record contents of DSKY Row 1 XXXXY
VERB 21 NOUN 01 ENTR
000370 ENTR
XXXXY' ENTR
Where Y' is obtained from Table 1a.
VERB 57 ENTR
00003 ENTR

6.3.14.8 Verify CRT DSKY display is:

VERB 06 NOUN 61 flashing
R1 = +13500 (SM Azimuth)
R2 = +40748 (Site Latitude)

NOTE: If R1 and R2 indications are correct proceed to step 6.3.14.10.

6.3.14.9 On K-148 enter:

VERB 21 ENTR
+13500 ENTR
VERB 22 ENTR
+40748 ENTR

6.3.14.10 On K-148 enter:

VERB 23 ENTR
Observe on CRT DSKY display
VERB 21 NOUN 30 (Flashing)

6.3.14.11 On K-148 enter:

0000X ENTR (Test position, either 1 or 2)
00000 ENTR (Use AOT)
Observe on CRT DSKY display:
VERB 06 NOUN 61 (Flashing)
Disregard Row 1, 2, and 3 indications

6.3.14.12 On K-148 enter:

VERB 21 ENTR
+XXX.XX ENTR (L tgt. true azimuth from 6.3.15.1.14)
VERB 22 ENTR
+XX.XXX ENTR (L tgt. elevation from 6.3.15.1.3)
VERB 23 ENTR
00001 ENTR (L tgt. number)
VERB 33 ENTR

Observe on CRT DSKY display:

VERB 06 NOUN 61 (Flashing)

Disregard Row 1, 2 and 3 indications.

6.3.14.13 On K-148 enter:

VERB 21 ENTR
+XXX.XX ENTR (F tgt. true azimuth from 6.3.15.1.14)
VERB 22 ENTR
+XX.XXX ENTR (F tgt. elevation from 6.3.15.1.12)
VERB 23 ENTR
00002 ENTR (F tgt. number)
VERB 33 ENTR

Observe on CRT DSKY display:

VERB 51 (flashing)

R1 - 00001

6.3.14.14 On Computer Control and Reticle Dimmer Assembly, press MARK X pushbutton.

Observe on DSKY display:

VERB 21 NOUN 30 (Flashing)

6.3.14.15 On DSKY press ENTR

Observe on DSKY display:

VERB 21 NOUN 43 (Flashing)

6.3.14.16 On DSKY enter:

00001 ENTR (1. Detent Code)

Observe on DSKY display

VERB 21 NOUN 43 (Flashing)

6.3.14.17 Set AOT to "L" position

6.3.14.18 Rotate AOT control knob until the center of the L tgt reticle is super imposed between the double Y reticle. Record AOT counter value as LY XXX.XX.

6.3.14.19 Rotate AOT control knob until the center of the L tgt reticle is superimposed between the double lines of the SPIRAL reticle. Record AOT counter value as LS XXX.XX.

6.3.14.20 On DSKY enter:

*XXX.XX ENTR (value of LY)

Observe on DSKY display:

VERB 22 NOUN 43 (Flashing)

6.3.14.21 On DSKY enter:

*XXX.XX ENTR (Value of LS)

Observe on DSKY display:

VERB 51 (Flashing)

R1 - 00002

6.3.14.22 On Computer Control and Reticule Dimmer Assembly, press MARK X pushbutton. Observe on DSKY display:

VERB 21 NOUN 30 (Flashing)

6.3.14.23 On DSKY press ENTR. Observe on DSKY display:

VERB 21 NOUN 43 (Flashing)

6.3.14.24 On DSKY enter:

00002 ENTR (F Detent Code)

Observe on DSKY display:

VERB 21 NOUN 42 (Flashing)

6.3.14.25 Set AOT to "F" position

6.3.14.26 Rotate AOT control knob until the center of the F tgt. reticle is superimposed between the double Y reticle. Record AOT counter value as FY XXX.XX.

6.3.14.27 Rotate AOT control knob until the center of the F tgt. reticle is superimposed between the double lines of the SPIRAL reticle. Record AOT counter value as FS XXX.XX.

6.3.14.28 On DSKY enter:

*XXX.XX ENTR (value of FY)

Observe on DSKY display:

VERB 22 NOUN 42 (Flashing)

6.3.14.29 On DSKY enter:

*XXX.XX ENTR (value of FS)

NOTE: Wait until DSKY display indicates VERB 51 (Flashing) R1 = 00001 before proceeding.

NOTE: Before completing step 6.3.14.30 check time of day to verify that the high order scalar will not overflow within the next 12 minutes.

6.3.14.30 Repeat steps 6.3.14.14 through 6.3.14.29.

6.3.14.31 In approximately 7 minutes, observe on CRT DSKY display and record.

VERB 06 NOUN 66 (Flashing)

R1 = XXXXX (Where number part of Y_{sm} misalignment about Z_{sm})

R2 = .XXXXX (Fractional number part of Y_{sm} misalignment about Z_{sm} .)

6.3.14.32 On K-148 enter.

VERB 33 ENTR

Observe on CRT DSKY display and record:

VERB 06 NOUN 66 (Flashing)

R1 = XXXXX (Whole number part of Z_{sm} misalignment about Y_{sm})

R2 = .XXXXX (Fractional number part of Z_{sm} misalignment about Y_{sm})

6.3.14.33 On K-148 enter:

VERB 36 ENTR

Press ERROR RESET

6.3.14.34 Repeat steps 6.3.14.7 through 6.3.14.30.

6.3.14.35 In approximately 7 minutes, observe on CRT DSKY display and record:

VERB 06 NOUN 66 (Flashing)

R1 = XXXXX (Whole number part of X_{sm} misalignment about Y_{sm})

R2 = .XXXXX (Fractional number part of X_{sm} misalignment about Y_{sm})

6.3.14.36 On K-148 enter:

VERB 33 ENTR

Observe on CRT DSKY display and record:

VERB 06 NOUN 66 (Flashing)

R1 = XXXXX (Whole number part of Y_{sm} misalignment about X_{sm})

R2 = .XXXXX (Fractional number part of Y_{sm} misalignment about X_{sm})

6.3.14.37 On K-148 enter:

VERB 36 ENTR

Press ERROR RESET

VERB 41 NOUN 20 ENTR

+00000 ENTR

+00000 ENTR

+00000 ENTR

6.3.14.38 Results. The PIPA bias determined previously in the IMU Performance Test (6.3.9) must be subtracted from the resultant data of the test. The PIPA bias terms from paragraph 6.3.9 must be multiplied by a factor of 210 before performing the calculations in paragraphs 6.3.14.38.1 thru 6.3.14.38.4.

6.3.14.38.1 Y PIPA misalignment

	R1	R2
About Z axis (from 6.3.14.31) =	\pm XXXXXX.	XXXXXX $\widehat{\text{sec}}$
Less Y PIPA bias (from 6.3.9) =	$-(\pm$ XXXXXX.	XXXXXX) $\widehat{\text{sec}}$
Y PIPA misalignment about Z axis =	-----	----- $\widehat{\text{sec}}$
This value shall not exceed $\pm 600 \widehat{\text{sec}}$		

6.3.14.38.2 Z PIPA misalignment

	R1	R2
About Y axis (from 6.3.14.32) =	\pm XXXXXX.	XXXXXX $\widehat{\text{sec}}$
Less Z PIPA bias (from 6.3.9) =	$-(\pm$ XXXXXX.	XXXXXX) $\widehat{\text{sec}}$
Z PIPA misalignment about Y axis =	-----	----- $\widehat{\text{sec}}$
This value shall not exceed $\pm 600 \widehat{\text{sec}}$		

6.3.14.38.3 X PIPA misalignment

	R1	R2
About Y axis (from 6.3.14.35) =	\pm XXXXXX.	XXXXXX $\widehat{\text{sec}}$
Less X PIPA bias from (6.3.9) =	$-(\pm$ XXXXXX.	XXXXXX) $\widehat{\text{sec}}$
X PIPA misalignment about Y axis =	-----	----- $\widehat{\text{sec}}$
This value shall not exceed $\pm 600 \widehat{\text{sec}}$		

6.3.14.38.4 Y PIPA misalignment

	R1	R2
About X axis from (6.3.14.36) =	\pm XXXXXX.	XXXXXX $\widehat{\text{sec}}$
Less Y PIPA bias (from 6.3.9) =	$-(\pm$ XXXXXX.	XXXXXX) $\widehat{\text{sec}}$
Y PIPA misalignment about X axis =	-----	----- $\widehat{\text{sec}}$
This value shall not exceed $\pm 600 \widehat{\text{sec}}$		

6.3.15 AOT Functional Accuracy Test.

NOTE: Use of a Dioptrimeter is required when sighting through AOT. The included angles between target LOS shall be known to ± 10 arc seconds. The elevation of each target LOS shall be known to ± 15 arc seconds.

6.3.15.1 Insure that G&N System is in the Operate Mode.

6.3.15.2 On K-146 enter:

VERB 21	NOUN 03	ENTR
01462		ENTR
XXX.XX		ENTR (Detent L az data)
		ENTR
01463		ENTR
XXX.XX		ENTR (Detent F az data)
		ENTR
01464		ENTR
XXX.XX		ENTR (Detent R az data)
		ENTR
01465		ENTR
XXX.XX		ENTR (Detent L EL data)
		ENTR
01466		ENTR
XXX.XX		ENTR (Detent F EL data)
		ENTR
01467		ENTR
XXX.XX		ENTR (Detent R EL data)

6.3.15.3 Place the AOT in F detent position.

6.3.15.4 While viewing through the AOT instruct the target F operator to translate (vertically and laterally) and rotate (in azimuth and elevation) target F until the center of the target reticle appears in the center of the AOT reticle.

6.3.15.5 Level the Theodolite base while assuring that the center of the target reticle remains in the center of the AOT reticle.

6.3.15.6 When it has been assured that the Theodolite is level and the target reticle appears in the center of the AOT reticle zero the F theodolite azimuth dial.

6.3.15.7 Place the AOT in the L detent position.

6.3.15.8 While viewing through AOT instruct the target L operator to translate (vertically and laterally) and rotate (in azimuth and elevation) target L until the target reticle appears in the lower right quadrant of the AOT field of view.

6.3.15.9 Level the Theodolite base while assuring that the target reticle remains visible in the lower right quadrant of the AOT field of view.

6.3.15.10 When it has been assured that the Theodolite is level and the target reticle is visible, zero the L Theodolite azimuth dial.

6.3.15.11 Place the AOT in the R detent position.

6.3.15.12 While viewing through AOT instruct the target R operator to translate (vertically and laterally) and rotate (in azimuth and elevation) target R until the target reticle appears in the lower left quadrant of the AOT field of view.

6.3.15.13 Level the Theodolite base while assuring that the target reticle remains visible in the lower left quadrant of the AOT field of view.

6.3.15.14 When it has been assured that the Theodolite is level and the target reticle is visible, zero the R theodolite azimuth dial.

6.3.15.15 Verify that target Theodolite L, F and R bases are level. Place the AOT in each Detent position from left to right and verify that each target reticle is still visible and in the proper field of view. If adjustments are required insure that the azimuth dial is rezeroed. Repeat this target scanning process until the AOT operator is satisfied with target placement.

6.3.15.16 AOT Measurement of X_1 .

6.3.15.16.1 On K-148 enter:

VERB 57	ENTR
00012	ENTR
Observe VERB 51 flashing and R1 = 00001 on CRT DSKY display.	

6.3.15.16.2 On Computer Control and Reticle Dimming Assembly press MARK X pushbutton.

6.3.15.16.3 Observe VERB 21 NOUN 30 flashing on DSKY.

6.3.15.16.4 On DSKY enter:

00000	ENTR
Observe VERB 21	NOUN 43 flashing
00001	ENTR
Observe VERB 21	NOUN 42 flashing

6.3.15.16.5 Set AOT in L detent position.

6.3.15.16.6 Rotate the AOT control knob clockwise until the center of the target reticle is superimposed between the double Y reticle. Read and record as LY = XXX.XX.

6.3.15.16.7 Rotate the AOT control knob until the center of the target reticle is superimposed between the double SPIRAL lines of AOT reticle. Record AOT dial indication as LS XXX.XX.

6.3.15.16.8 Record target L Theodolite elevation angle from horizontal as θ_1 .

6.3.15.16.9 On DSKY enter:

▲XXX.XX		ENTR (LY from 6.3.15.16.6)
Observe	VERB 22	NOUN 42 flashing
▲XXX.XX		ENTR (LS from 6.3.15.16.7)
Observe	VERB 51 flashing and R1 = 00002.	

6.3.15.16.10 On Computer Control and Reticle Dimming Assembly, press MARK X pushbutton.

6.3.15.16.11 Observe VERB 21 NOUN 30 flashing on DSKY.

6.3.15.16.12 On DSKY enter:

00000		ENTR
Observe	VERB 21,	NOUN 43 flashing
00002		ENTR
Observe	VERB 21,	NOUN 42 flashing

6.3.15.16.13 Set AOT in F detent position.

6.3.15.16.14 Rotate AOT control knob clockwise until the center of the target reticle is superimposed between the double Y reticle. Record AOT dial indication as FY = XXX.XX.

6.3.15.16.15 Rotate the AOT control knob until the center of the target reticle is superimposed between the double S reticle lines. Record AOT dial indication as FS = XXX.XX.

6.3.15.16.16 Record target F Theodolite elevation angle from horizontal as θ_2 .

6.3.15.16.17 On DSKY enter:

▲XXX.XX		ENTR (FY from 6.3.15.16.14)
Observe	VERB 22	NOUN 42 flashing
▲XXX.XX		ENTR (FS from 6.3.15.16.15)
Observe	VERB 06	NOUN 03 displayed
Record R1		

6.3.15.17 AOT Measurement of X2.

6.3.15.17.1 On K-148 enter:

VERB 57		ENTR
00012		ENTR
Observe	VERB 51 flashing and R1 = 00001 on CRT DSKY display.	

6.3.15.17.2 On Computer Control and Reticle Dimming Assembly, press MARK X pushbutton.

6.3.15.17.3 Observe VERB 21 NOUN 30 flashing on DSKY.

6.3.15.17.4 On DSKY enter:

00000		ENTR
Observe	VERB 21	NOUN 43 flashing
00001		ENTR
Observe	VERB 21	NOUN 42 flashing
▲XXX.XX		ENTR (LY from 6.3.15.16.6)
Observe	VERB 22	NOUN 42 flashing
▲XXX.XX		ENTR (LS from 6.3.15.16.7)
Observe	VERB 51	flashing and R1 = 00002.

6.3.15.17.5 On Computer Control and Reticle Dimming Assembly, press MARK X pushbutton.

6.3.15.17.6 Observe VERB 21, NOUN 30 flashing on DSKY.

6.3.15.17.7 On DSKY enter:

00000		ENTR
Observe	VERB 21	NOUN 43 flashing
00003		ENTR
Observe	VERB 21	NOUN 42 flashing

6.3.15.17.8 Set AOT in R detent position.

6.3.15.17.9 Rotate AOT control knob clockwise until the center of the target reticle is superimposed between the double Y reticle. Record AOT dial indication as RY = XXX.XX.

6.3.15.17.10 Rotate AOT control knob until the center of the target reticle is superimposed between the double SPIRAL reticle lines. Record AOT dial indication as RS = XXX.XX.

6.3.15.17.11 Record target R theodolite elevation angle from horizontal as θ_3 .

6.3.15.17.12 On DSKY enter:

▲XXX.XX		ENTR (RY from 6.3.15.17.9)
Observe	VERB 22	NOUN 42 flashing
▲XXX.XX		ENTR (RS from 6.3.15.17.10)
Observe	VERB 06	NOUN 03 displayed
Record R1.		

6.3.15.18 Theodolite measurement of X_1 and X_2 .

6.3.15.18.1 Collimate Theodolite L and F. Read azimuth angle indicated by L Theodolite. Subtract angle from 360.00° and record as α_1 . Read and record the azimuth angle indicated by F Theodolite as α_2 .

6.3.15.16.2 Collimate Theodolite L and R. Read azimuth angle indicated by R Theodolite and record as \angle_3 . Read and record the azimuth angle indicated by L Theodolite. Subtract angle from 360° and record as \angle'_1 .

6.3.15.16.3 Calculate the values of the included angles between target L and F as X_1 and targets L and R as X_2 .

$$X_1 = \cos^{-1} \left\{ \sin \beta_1 \sin \beta_2 + \cos \beta_1 \cos \beta_2 \cos [(180 - (\angle_1 + \angle_2))] \right\}$$

$$X_2 = \cos^{-1} \left\{ \sin \beta_1 \sin \beta_3 + \cos \beta_1 \cos \beta_3 \cos [(180 - (\angle_3 + \angle'_1))] \right\}$$

6.3.15.19 The angle recorded in 6.3.15.16.17 shall equal $X_1 \pm 0.05^\circ$.

6.3.15.20 The angle recorded in 6.3.15.17.12 shall equal $X_2 \pm 0.05^\circ$.

APPENDIX I

MEASUREMENT TOLERANCES

<u>SIGNAL</u>	<u>SIGNAL NAME</u>	<u>G&N LAB TEST REQUIREMENT</u>	<u>PSAAM AND/OR SCA UNCERTAINTY 1% OF FULL SCALE</u>
GG 1030 link 4*	+14 vdc LGC Supply	14.0±0.4 vdc	0%
GG 1030 link 4	+4 vdc LGC Supply	4.0±0.2 vdc	0%
GG 1040 link 5**	+120 vdc PIPA Supply	120±6.0 vdc	1%
GG 1070 link 4	+4 vdc CDU Supply	4.0±0.2 vdc	0%
GG 1100 link 4	-28 vdc Supply	-27.5±6.0 vdc	0%
GG 1110 link 5	2.5 vdc Telemetry Bias No. 1	2.5±0.06 vdc	0%
GG 1201 link 5	IMU 28V 800 cps 1%	28±0.56V rms	1%
GG 1202 link 4	IMU 28V 800 cps 5%	28±1.4V rms	1.5%
GG 1203 link 4	IMU 28V 800 cps 5%	28±2.1V rms	1.5%
GG 1331 link 5	3.2 kc 28V Supply 1%	28.6±0.56V rms	1%
GG 1500 link 4	+28 vdc IMU Oper BUS	28.0 -3.5, +5.5 vdc	0%
GG 1510 link 4	+28 vdc IMU STBY BUS	28.0 -6.0, +5.5 vdc	0% IMU STBY } ON only }
GG 1513X link 5	+28 vdc IMU STBY/OFF	28.0±1 vdc	0%
GG 1520 link 4	+28 vdc LGC Oper BUS	28.0 ±4.5, vdc	0%
GG 1523X link 5	+28 vdc LGC Operate	28.0±1 vdc	0%
GG 2001 link 5	X PIPA S.G. OUT IN PH	+2.5±0.128V rms at 1g	3%
GG 2021 link 5	Y PIPA S.G. OUT IN PH	+2.5±0.128V rms at 1g	3%
GG 2041 link 5	Z PIPA S.G. OUT IN PH	+2.5±0.128V rms at 1g	3%
GG 2106 link 4	IG Servo Error Total	0.0±60 MV rms at null	1%
GG 2107 link 5	IG Servo Error IN PH	0.0±60 MV rms at null	2%
GG 2110 link 4	IG Torque Motor Current	0.5 AMP Max during any fine Align Torque	0%
GG 2110 link 5	IG Torque Motor Current	0.5 AMP Max during any fine Align Torque	1%
GG 2112 link 5	IG 1X Resolver Out-Sine	18.4±1.84V rms at 45°	2.5%
GG 2113 link 5	IG 1X Resolver Out-Cosine	18.4±1.84V rms at 45°	2.5%
GG 2121 link 5	IG 1X Resolver Out-Sine 11°	5.35±0.27V rms at 11°	2%
GG 2136 link 4	MG Servo Error Total	0.0±60 MV rms at null	1%
GG 2137 link 5	MG Servo Error IN PH	0.0±60 MV rms at null	2%
GG 2140 link 4	MG Torque Motor Current	0.5 AMP Max during any fine Align Torque	0%
GG 2140 link 5	MG Torque Motor Current	0.5 AMP Max during any fine Align Torque	1%
GG 2142 link 5	MG 1X Resolver Out-Sine	18.4±1.84V rms at 45°	2.5%
GG 2143 link 5	MG 1X Resolver Out-Cosine	18.4±1.84V rms at 45°	2.5%
GG 2151 link 5	MG 1X Resolver Out-Sine 11°	5.35±0.27V rms at 11°	2%
GG 2166 link 4	OG Servo Error Total	0.0±60 MV rms at null	1%
GG 2167 link 5	OG Servo Error IN PH	0.0±60 MV rms at null	2%
GG 2170 link 4	OG Torque Motor Current	0.9 AMP Max during any fine Align Torque	0%
NG 1336 link 4	PH DIFF 3.2kc	0° ±10°	3%
GG1510 Link 4	28V/LGC SYNC +28 VDC IMU STBY BUS IMU STBY ON-IMU OPER ON	28.0 -4.5, +4.5 vdc	0%

APPENDIX I (Continued)

<u>SIGNAL</u>	<u>SIGNAL NAME</u>	<u>G&N LAB TEST REQUIREMENT</u>	<u>PSAAM AND/OR SCA UNCERTAINTY % OF FULL SCALE</u>
GG 2170 link 5	OG Torque Motor Current	0.9 AMP Max during any fine Align Torque	1%
GG 2172 link 5	OG 1X Resolver Out-Sine	18.4±1.84V rms at 45°	2.5%
GG 2173 link 5	OG 1X Resolver Out-Cosine	18.4±1.84V rms at 45°	2.5%
GG 2181 link 5	OG 1X Resolver Out-Sine 11°	5.35±0.27V rms at 11°	2%
GG 2219 link 5	Pitch Attitude Error	5.05±0.5V rms at 17°	1%
GG 2220 link 4	IG CDU Fine Error	0.0±0.07V rms at null	1%
GG 2221 link 4	IG CDU Coarse Error	0.0±0.68V rms at null	1%
GG 2249 link 5	YAW Attitude Error	5.05±0.5V rms at 17°	1%
GG 2250 link 4	MG CDU Fine Error	0.0±0.07V rms at null	1%
GG 2251 link 4	MG CDU Coarse Error	0.0±0.68V rms at null	1%
GG 2279 link 5	Roll Attitude Error	5.05±0.5V rms at 17°	1%
GG 2280 link 4	OG CDU Fine Error	0.0±0.07V rms at null	1%
GG 2281 link 4	OG CDU Coarse Error	0.0±0.68V rms at null	1%
GG 2300 link 5	PIPA Temperature	130.5±1.5°F in Operate	1%
GG 2301 link 4	IRIG Temperature	135±2.5°F in Operate	1%
GG 2301 link 5	IRIG Temperature	135±2.5°F in Operate	1%
GG 2302 link 4	IMU Heater Current On	28±1 vdc	0%
GG 2303 link 4	IMU Blower Current On	28±1 vdc	0%
GG 3304 link 5	RR Shaft 1X Resolver Out-Sine	19.65±0.98V rms at 45°	2.5%
GG 3305 link 5	RR Shaft 1X Resolver Out-Cosine	19.65±0.98V rms at 45°	2.5%
GG 3311 link 4	RR Shaft CDU Fine Error	0.0±0.07V rms at null	1%
GG 3312 link 4	RR Shaft CDU Coarse Error	0.0±0.68V rms at null	1%
GG 3321 link 4	RR Trunnion CDU Fine Error	0.0±0.07V rms at null	1%
GG 3322 link 4	RR Trunnion CDU Coarse Error	0.0±0.68V rms at null	1%
GG 3324 link 5	RR Trunnion 1X Resolver Out-Sine	19.65±0.98V rms at 45°	2.5%
GG 3325 link 5	RR Trunnion 1X Resolver Out-Cosine	19.65±0.98V rms at 45°	2.5%
GG 4300 link 4	LGC Temperature	87.5±22.5°F	0%
GG 6020 link 4	PIPA Calibration Module Temperature	67.5±22.5°F	0%
GG 6020 link 5	PIPA Calibration Module Temperature	67.5±22.5°F	0%
GG 6021 link 4	PSA Temperature	85±25.0°F	0%

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<u>SIGNAL</u>	<u>SIGNAL NAME</u>	<u>G&N LAB TEST REQUIREMENT</u>	<u>PSAAM AND/OR SCA UNCERTAINTY OF FULL SCALE</u>
NG1021 link 4	14 VDC LGC Noise RMS	0.4 VRMS Max	0%
NG1022 link 4	14 VDC LGC Noise Peak	5 volts with rise time of 2 to 5 usec	0%
NG1031 link 4	4 VDC LGC Noise RMS	0.4 VRMS Max	0%
NG1032 link 4	4 VDC LGC Noise Peak	5 volts with rise time of 2 to 50 used	0%
NG1071 link 4	4 VDC CDU Noise RMS	1.0 VRMS Max	0%
NG1072 link 4	4 VDC CDU Noise Peak	5 volts with rise time of 2 to 50 usec	0%
NG1501 link 4	28 VDC IMU Operate Noise RMS	1.0 VRMS Max	0%
NG1502 link 4	28 VDC IMU Operate Noise Peak	5 volts with rise time of 2 to 50 usec	0%
NG1511 link 4	28 VDC IMU Standby Noise RMS	1.0 VRMS Max	0%
NG1512 link 4	28 VDC IMU Standby Noise Peak	5 volts with rise time of 2 to 50 usec	0%
NG1521 link 4	28 VDC LGC Operate Noise RMS	1.0 VRMS Max	0%
NG1522 link 4	28 VDC LGC Operate Noise Peak	5 volts with rise time of 2 to 50 usec	0%

*Link 4 - PSAAM Output Signal

**Link 5 - SCA Output Signal

ADDENDUM 1

LM-1 and LM-2

ADDITION 1: The following procedure will be performed for LM-1 and LM-2 only.

6.3.16 Gyrocompassing Test

6.3.16.1 Insure that the IMU Operate power and LGC Operate power has been applied for a minimum of one hour and that the IMU is not in a Gimbal Lock condition.

6.3.16.2 On K-148 enter the following sequence:

VERB 57 ENTR
00006 ENTR

6.3.16.3 VERB 06 NOUN 61 shall flash.

6.3.16.4 The CRT, DSKY display shall display Launch Azimuth. (Launch Azimuth shall be the GAEC Navigator Base Azimuth defined by GAEC).

6.3.16.5 If value for Row 1 is correct, proceed to the next step. If value for Row 1 is incorrect, enter the following into K-148:

VERB 21 ENTR
XXXXXX ENTR Correct launch azimuth (GAEC Nav Base Az)

Verify value in Row 1 is correct.

6.3.16.6 On K-148 enter the following:

VERB 33 ENTR

6.3.16.7 VERB 06 NOUN 61 shall flash.

6.3.16.8 The CRT, DSKY display shall display Navigation Base Azimuth and Latitude, respectively.

6.3.16.9 If the values for Row 1 and Row 2 are correct, proceed to the next step. If the values for Row 1 or Row 2 are incorrect, enter the following into K-148.

If Row 1 is incorrect: VERB 21 ENTR
 XXXXXX ENTR (Correct Nav Base Azimuth)

If Row 2 is incorrect: VERB 22 ENTR
 +40.748 ENTR (Correct Site Latitude)

Verify values for Row 1 and Row 2 are correct.

6.3.16.10 On K-148 enter the following:

VERB 33 ENTR
VERB 16 NOUN 20 ENTR

6.3.16.11 One hour after step 6.3.16.10 has been performed, read and record CRT DSKY display of Row 1, Row 2, and Row 3.

6.3.16.12 Obtain and record the latest measured value of the following data.

6.3.16.12.1 NBDX

6.3.16.12.2 NBDY

6.3.16.12.3 NBDZ

6.3.16.12.4 ADIAZ

6.3.16.12.5 ADSRAY

6.3.16.12.6 GAEC NB YZ plane about Z local vertical.

6.3.16.12.7 GAEC NB YZ plane about Y local vertical.

6.3.16.13 Calculate the vertical and east IREG coefficient drift contribution to azimuth error (ϕ Vert).

a. Drift (vert) = $NBDZ + ADIAZ =$ _____ mers

b. Drift (east) = $NBDX \sin \alpha + NBDY \sin (\alpha + 90) + ADSRAY \sin (\alpha + 90)$
Where α = Launch Azimuth

c. ϕ vert = $\frac{a \cdot 95a + 172b}{3600} =$ _____ degrees

6.3.16.14 Algebraically add ϕ (vert) from the Row 1 DSKY display recorded in 6.3.16.11. The resultant azimuth error shall be 000.00 ± 000.57 degrees.

6.3.16.15 Algebraically subtract the value recorded in 6.3.16.12.6 from the Row 3 DSKY display recorded in 6.3.16.11. The resultant vertical error about Z local vertical shall be 000.00 ± 000.06 degrees.

6.3.16.16 Algebraically subtract the value recorded in 6.3.16.12.7 from the Row 2 DSKY display recorded in 6.3.16.11. The resultant vertical error about Y local vertical shall be 000.00 ± 000.06 degrees.

6.3.16.17 Two hours after 6.3.16.10 has been performed, read and record CRT DSKY display of Row 1, Row 2, and Row 3.

6.3.16.18 The CRT DSKY display of Row 1 shall be within 000.06 degrees of the value recorded in 6.3.16.11. The CRT DSKY display of Row 2 and Row 3 shall be within 000.03 degrees of the respective values recorded in 6.3.16.11.

6.3.16.19 On K-148 enter the following:

VERB 36		ENTR
VERB 40	NOUN 20	ENTR
+00000		ENTR
+00000		ENTR
+00000		ENTR

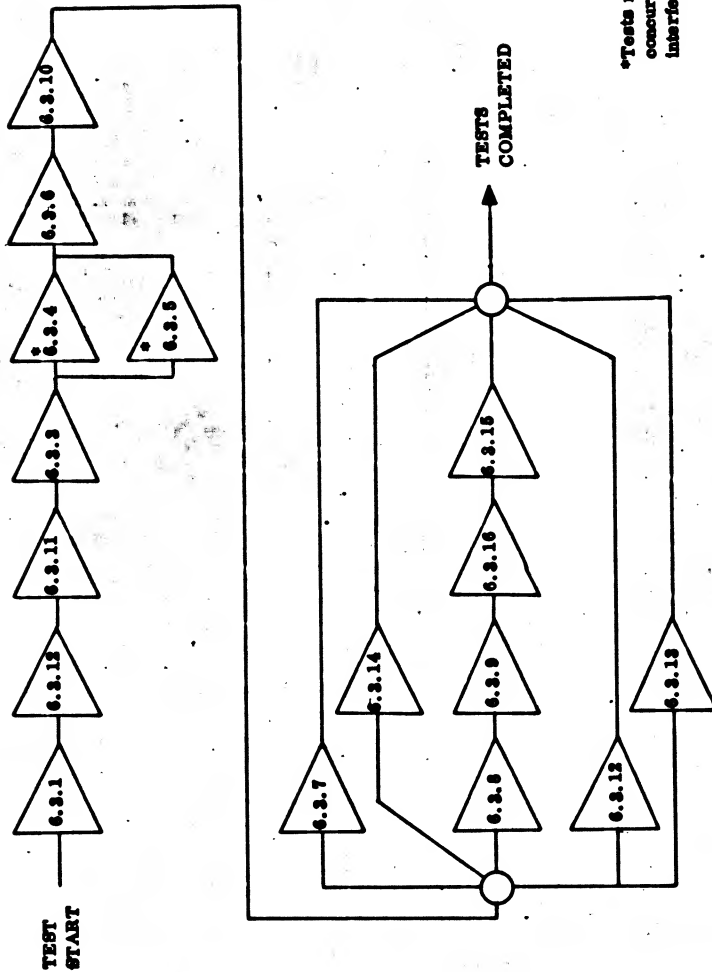
ADDENDUM 1

LM-10-105 LM-2

Addition 2: Perform LM-1 and LM-2 test in accordance with the following Flowgram.

Addition 3: Place a note after paragraph 6.2.1.6.2.

NOTE: If the LMP Interlock CB is energized insure that the ATCA switch on LEM Panel 16 and the ATCA/PGNCS switch on Panel 11 are in the off position before performing the following steps.



*Tests may be performed
occurencly on a non-
interference basis

TEST PROCEDURE FLOWGRAM

FIGURE 1

ADDENDUM II
AURORA 85

Following are the changes required to make this document applicable for checkout of a G&N System with an Aurora 85 Test Rope.

Addition 1. Paragraph 6.3.7 PGNCB Operational Test

- a. Delete paragraphs 6.3.7.15.2 and 6.3.7.15.3
- b. Subtract an Octal 1 from each of the NOUN display requirements in paragraphs 6.3.7.20.1, 6.3.7.20.3, 6.3.7.20.5, 6.3.7.20.7, 6.3.7.20.9, 6.3.7.20.11 and 6.3.7.20.13.

Addition 2. Paragraph 6.3.8 IRIG Scale Factor Test

- a. Change Paragraph 6.3.8.22 to read as follows:

The average of the three readings of Scale Factor Error for each of the 6 positions shall be 556±1750 PPM.

Addition 3. Paragraph 6.3.9 IMU Performance Test.

- a. Add the following note prior to step 6.3.9.23.

NOTE: Paragraph 6.3.9.24 must be performed within one minute after VERB 06 and NOUN 66 flash in paragraph 6.3.9.23. In the event a PEOG alarm is obtained enter VERB 36, press the ENTER pushbutton and repeat paragraphs 6.3.9.8 through 6.3.9.24.

- b. Add the following note prior to step 6.3.9.36.

NOTE: Paragraph 6.3.9.39 must be performed within one minute after VERB 06 and NOUN 66 flash in paragraph 6.3.9.38. In the event a PEOG alarm is obtained enter VERB 36, press ENTER and repeat paragraphs 6.3.9.8 through 6.3.9.1. Enter the following in K-148.

VERB 36	ENTER
+00600	ENTER
+00000	ENTER
+00003	ENTER

Repeat paragraphs 6.3.9.28 through 6.3.9.39.

6.2.17.4.4 On K-148 enter the following:

Press ERR RST
VERB 36 ENTR
VERB 41 NOUN 40 ENTR
+00000 ENTR
+03375 ENTR
VERB 34 ENTR
VERB 21 NOUN 10 ENTR
00012 ENTR
00001 ENTR

Verify RR CDU Fail comes ON in approximately 90 seconds.

ADDENDUM III RR INTERFACE
LTA-8, (MSC) - LM-3 and Subsequent

RR CDU testing requires that the Rendezvous Radar is operating. The Rendezvous Radar is not activated until Integrated testing. To insure that the RR CDU's are operating properly the minimum requirements for RR CDU testing are presented here so that they may be included as part of the requirements to be demonstrated at the first opportunity after Rendezvous Radar activation.

6.3.17 RR/CDU Control

6.3.17.1 Command Accuracy 24000°

6.3.17.1.1 On K-148 enter the following

VERB 36	ENTR
VERB 41 NOUN 40	ENTR
+24000	ENTR
+24000	ENTR
VERB 34	ENTR

The CRT RR CDU Trunnion and Shaft angle indications shall be 240.00±000.30°.

6.3.17.2 CDU Fine and CDU Coarse Error

6.3.17.2.1 Set up analog recorder to monitor the following:

<u>Meas. No.</u>	<u>Signal Name</u>
a. GG3311	Shaft CDU Fine Error
b. GG3312	Shaft CDU Coarse Error
c. GG3321	Trunnion CDU Fine Error
d. GG3322	Trunnion CDU Coarse Error

6.3.17.2.2 On K-148 enter the following:

VERB 36	ENTR
VERB 41 NOUN 40	ENTR
+04500	ENTR
+04500	ENTR
VERB 34	ENTR

6.3.17.2.3 Verify the following signals on the CRT.

RR Shaft 1X Sin (GG3304)	18.4±1.84 VRMS
RR Shaft 1X Cos (GG3305)	18.4±1.84 VRMS
RR Trunnion 1X Sine (GG3324)	18.4±1.84 VRMS
RR Trunnion 1X Cos (GG3325)	18.4±1.84 VRMS

- 6.3.17.2.4 Verify that no CDU Fine Error (GG3311, GG3321) exceeds .070 volts.
6.3.17.2.5 Verify that no CDU Coarse Error (GG3312, GG3322) exceeds .680 volts.
6.3.17.3 Deleted.
6.3.17.3.1 Deleted.
6.3.17.3.2 Deleted.

VERB 10 NOUN 40 ENTR

Wait 10 seconds then record the CRT RR CDU Trunnion and Shaft indications;
the recorded value shall be within $\pm 000.01^\circ$ of the value recorded above.

- 6.3.17.4 RR CDU Fail

- 6.3.17.4.1 On K-148 Enter the following:

VERB 36	ENTR
VERB 41 NOUN 40	ENTR
+00100	ENTR
+00000	ENTR
VERB 34	ENTR
VERB 21 NOUN 10	ENTR
00012	ENTR
00001	ENTR

Verify RR CDU Fail comes ON in approximately 10 seconds.

- 6.3.17.4.2 On K-148 enter the following:

Press ERR RST

VERB 36	ENTR
VERB 41 NOUN 40	ENTR
+00000	ENTR
+00100	ENTR
VERB 34	ENTR
VERB 21 NOUN 10	ENTR
00012	ENTR
00001	ENTR

Verify RR CDU Fail comes ON in approximately 10 seconds.

6.3.17.4.3 On K-148 enter the following:

Press ERR RST	
VERB 36	ENTR
VERB 41 NOUN 40	ENTR
+03375	ENTR
+00000	ENTR
VERB 34	ENTR
VERB 21 NOUN 10	ENTR
00012	ENTR
00001	ENTR

Verify RR CDU Fail comes ON in approximately 10 seconds.

6.3.17.4.4 On K-148 enter the following:

Press ERR RST	
VERB 36	ENTR
VERB 41 NOUN 40	ENTR
+00000	ENTR
+03375	ENTR
VERB 34	ENTR
VERB 21 NOUN 10	ENTR
00012	ENTR
00001	ENTR

Verify RR CDU Fail comes ON in approximately 10 seconds.

6.3.17.4.5 On K-148 enter the following:

Press ERR RST	
VERB 36	ENTR
VERB 41 NOUN 40	ENTR
+00000	ENTR
+00000	ENTR
VERB 34	ENTR

ADDENDUM IV

LM-4 and Subsequent Spacecraft Measurement Deletions

- Addition 1: Delete last sentence of Paragraph 6.3.4.2.
Addition 2: Delete last two sentences of Paragraph 6.3.4.3.
Addition 3: Delete Paragraphs 6.3.7.23 and 6.3.7.24.
Addition 4: Change Paragraph 6.3.7.25 to read as follows:

6.3.7.25 On K-148, enter the following:
VERB 38 ENTR
VERB 41 NOUN 30 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR

[illegible]

A - Wait until GENERAL LOCK lamp goes out before performing this step.

2 - On E-148 enter the following

C - When VIMS 06 HCU 66 flashes do not record test results.

- 6.3.5.2 The PIPA Calibration Module Temperature (GG6020) shall be between +45 and +90 DEG F.
- 6.3.5.3 The PSA Temperature (GG6021) shall be between +60 and +110 DEG F.
- 6.3.5.4 The LGC Temperature (GG4300) shall be between +45 and +130 DEG. F.
- 6.3.5.5 The +28 VDC IMU OPERATE BUS (GG1500) shall be between 24.5 and 33.5 VDC.
- 6.3.5.6 The +28 VDC IMU STANDBY BUS (GG1510) shall be between 23.5 and 32.5 VDC.
- 6.3.5.7 The +28 VDC LGC OPERATE BUS (GG1520) shall be between 29.5 and 33.5 VDC.
- 6.3.5.8 The +120 VDC PIPA Supply (GG1040) shall be between 114 and 126 VDC.
- 6.3.5.9 The -28 VDC Supply (GG1100) shall be between -21.5 and -33.5 VDC.
- 6.3.5.10 The +4 VDC CDU Supply (GG1070) shall be between 3.8 and 4.2 VDC.
- 6.3.5.11 The IMU 28V 800 CPS 1 pot Supply (GG1201) shall be between 27.44 and 28.56 VRMS.
- 6.3.5.12 The IMU 28V 800 CPS 5 pot 90 PH Supply (GG1202) shall be between 26.6 and 29.4 VRMS.
- 6.3.5.13 The IMU 28V 800 CPS 5 pot 0 PH Supply (GG1203) shall be between 25.9 and 30.1V RMS.
- 6.3.5.14 The 3.2 KC 28V Supply (GG1331) shall be between 28.04 and 29.16V RMS.
- 6.3.5.15 The 2.5 VDC T/M Bias (GG1110) shall be between 2.44 and 2.56 VDC.
- 6.3.5.16 The +14 VDC LGC Supply (GG1020) shall be between 13.6 and 14.4 VDC.
- 6.3.5.17 The +4 VDC LGC Supply (GG1030) shall be between 3.8 and 4.2 VDC.
- 6.3.5.18 The phase difference between the 3.2 KC supply and LGC sync shall be 0° ±10° (NG1336).

6.3.6.8 From the CRT, DSKY display, read and record R1 and R2 (local gravity whole and fractional respectively). The value recorded shall be between 975.0 and 985.9 cm/sec².

6.3.6.9 On K-148 enter the following sequence.

VERB 33 ENTR
VERB 06 NOUN 66 shall flash

6.3.6.10 From the CRT, DSKY display, read and record the horizontal fractional component of earth rate acting on the X, Y, and Z IRIG's as displayed in R2. The value recorded shall be between .65750 and .85750.

6.3.6.11 Terminate the test by entering in K-148 the following:

VERB 33 ENTR
VERB 16 NOUN 40 DISPLAYED
VERB 34 ENTR
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR

6.3.7 PGNCB Operational Test

6.3.7.1 Enter the following sequence manually per 6.3.7.1.1.1 and 6.3.7.1.1.2 or tape load the sequence per steps 6.3.7.1.2.1 through 6.3.7.1.2.5.

6.3.7.1.1 Manual Input

6.3.7.1.1.1 On K-148, enter the following sequence:

VERB 36 ENTR
VERB 21 NOUN 01 ENTR
1220 ENTR
43733 ENTR
NOUN 15 ENTR
00006 ENTR, ENTR
03012 ENTR, ENTR
00004 ENTR, ENTR
13242 ENTR, ENTR
25563 ENTR, ENTR
01220 ENTR

6.3.7.1.1.2 On K-148 enter the following sequence:

a. VERB 21 NOUN 01 ENTR
b. 01300 ENTR
c. 40266 ENTR
d. NOUN 15 ENTR
e. 61304 ENTR ENTR
f. 10000 ENTR ENTR
g. 01325 ENTR ENTR
h. 00023 ENTR ENTR
i. 01325 ENTR ENTR
j. 25546 ENTR ENTR
k. 31344 ENTR ENTR
l. 54324 ENTR ENTR

m.	41345	ENTR ENTR
n.	60150	ENTR ENTR
o.	10000	ENTR ENTR
p.	01332	ENTR ENTR
q.	00050	ENTR ENTR
r.	01332	ENTR ENTR
s.	37640	ENTR ENTR
t.	04451	ENTR ENTR
u.	01337	ENTR ENTR
v.	42005	ENTR ENTR
w.	03545	ENTR ENTR
x.	04505	ENTR ENTR
y.	31315	ENTR ENTR
z.	04451	ENTR ENTR
aa.	01300	ENTR ENTR
ab.	42005	ENTR ENTR
ac.	04505	ENTR ENTR
ad.	31315	ENTR ENTR
ae.	04451	ENTR ENTR
af.	01307	ENTR ENTR
ag.	42005	ENTR ENTR
ah.	04505	ENTR ENTR
ai.	31346	ENTR ENTR
aj.	54150	ENTR ENTR
ak.	54331	ENTR ENTR
al.	06243	ENTR ENTR
am.	04505	ENTR ENTR
an.	00002	ENTR ENTR
ao.	43623	ENTR ENTR
ap.	43626	ENTR
aq.	VERB 25 NOUN 26	ENTR
ar.	00001	ENTR
as.	01300	ENTR
at.	42005	ENTR
au.	VERB 31	ENTR

6.3.7.1.1.3 Proceed to 6.3.7.1.3 after manual entry of above data.

6.3.7.1.2 Tape loaded input.

6.3.7.1.2.1 Verify K-START Tape G03L006-K10540-XX, SAMOD INHINT GUARD, is on K-START tape reader, where XX is the tape revision number.

6.3.7.1.2.2 Start tape reader.

6.3.7.1.2.3 When tape reader stops, verify the following on the CRT:

R1 = +03088
R2 = +10540 (tape number)
R3 = -000XX (tape revision number)

6.3.7.1.2.4 Start tape reader.

6.3.7.1.2.5 When tape reader stops, verify the following on the CRT:

R1 = 00101

6.3.7.1.3 Start the PGNCS Operational test by inserting the following sequence into K-148:

VERB 57 ENTR
00010 ENTR
Program 07 shall be displayed
VERB 33 NOUN 01 is displayed flashing

6.3.7.2 Command Accuracy 0°

6.3.7.2.1 On K-148, press ENTR

VERB 33 NOUN 02 is displayed flashing
On Event Module ISS WARNING Lamp may light
Press ENTR
VERB 33 NOUN 03 is displayed flashing

6.3.7.2.2 Read and record the CRT indication of IMU gimbal angles. The indications shall be 000 ± 001 degrees.

6.3.7.2.3 Read and record CRT the DSKY Row 1, 2, and 3 indications. The indications shall be $+00000 \pm 00007$.

6.3.7.3 Command Accuracy 45°

6.3.7.3.1 On K-148, press ENTR, VERB 33 NOUN 04 is displayed flashing after approximately 30 seconds.

6.3.7.3.2 Read and record the CRT indication of IMU gimbal angles. The indications shall be 045 ± 001 degrees.

6.3.7.3.3 Read and record the CRT DSKY Rows 1, 2, and 3 indications. The indications shall be $+04500 \pm 00007$.

6.3.7.4 CDU Repeating Accuracy 45°

6.3.7.4.1 On K-148 press ENTR. In about 90 seconds VERB 05 NOUN 30 is displayed flashing.

6.3.7.4.2 Read and record the CRT DSKY Rows 1, 2, and 3 indications. The indications shall be between 77774 and 00003.

6.3.7.5 Command Accuracy 90°

6.3.7.5.1 On K-148 Press VERB 33, ENTR. In approximately 20 seconds VERB 33 NOUN 06 is displayed flashing. The GIMBAL LOCK lamp on DSKY shall be lighted.

6.3.7.5.2 Read and record the CRT indication of IMU gimbal angles. The indications shall be 090 ± 001 degrees.

6.3.7.18 IMU CDU Fine Fail Test

6.3.7.18.1 On K-148 insert the following sequence

+00100 ENTR
+00100 ENTR
+00100 ENTR

On Event Module verify that ISS WARNING lamp lights in approximately 90 seconds.

6.3.7.18.2 After approximately 20 seconds, VERB 01 NOUN 10 shall be displayed. Verify that CRT DSKY display Row 1 indicates 33XXX or 32XXX.

6.3.7.19 IMU CDU Coarse Fail Test

6.3.7.19.1 Enter the following sequence manually per Step 6.3.7.19.1.1.1 or tape load the sequence per Step 6.3.7.19.2.1 and 6.3.7.19.2.2.

6.3.7.19.1.1 Manual Input

6.3.7.19.1.1.1 On K-148, enter

VERB 25 NOUN 26 ENTR
00001 ENTR
01300 ENTR
42005 ENTR
VERB 31 ENTR

6.3.7.19.1.2 Proceed to 6.3.7.19.3 after manual entry of above data.

6.3.7.19.2 Tape loaded input.

6.3.7.19.2.1 Start tape reader at tape section 00102.

6.3.7.19.2.2 When tape reader stops verify the following on the CRT:

R1 = 00102

6.3.7.19.3 On K-148, enter the following sequence:

VERB 33 ENTR
Wait for VERB 21 NOUN 22 flashing
+03375 ENTR
+03375 ENTR
+03375 ENTR

On Event Module, verify that ISS Warning Lamp lights in approximately 90 seconds.

6.3.7.19.4 After approximately 20 seconds, VERB 01 NOUN 10 shall be displayed. Verify that CRT DSKY display of Row 1 indicates 33XXX or 32XXX.

6.3.7.20 FDAI Linearity Test

6.3.7.20.1 On K-148, enter the following:

VERB 21 NOUN 01 ENTR
2545 ENTR
1220 ENTR
VERB 33 ENTR
VERB 33 NOUN 27 shall be displayed

6.3.7.20.2 On CRT verify the following:

PITCH ATT ERROR is between +15.3 and +18.7 DEG (GG2219)
YAW ATT ERROR is between +15.3 and +18.7 DEG (GG2249)
ROLL ATT ERROR is between +15.3 and +18.7 DEG (GG2279)

6.3.7.20.3 On K-148, enter the following:

VERB 21 NOUN 01 ENTR
2545 ENTR
01235 ENTR
VERB 33 ENTR
VERB 33 NOUN 30 shall be displayed

6.3.7.20.4 On CRT verify the following:

PITCH ATT ERROR is between +14.4 and +17.6 DEG (GG2219)
YAW ATT ERROR is between +14.4 and +17.6 DEG (GG2249)
ROLL ATT ERROR is between +14.4 and +17.6 DEG (GG2279)

6.3.9.6 Perform the following calculations:

- a. $\frac{BBBBB \times 5.12}{3600} = CCCC.C$ (Contents (hrs) of high order scalar register)
- b. $23.3 - CCCC.C = DDDD.D$ hours.
- c. $DDDD.D + \text{present time of day} = \text{time of day at which high order scalar register will overflow.}$

6.3.9.7 If the time of day is within 12 minutes of that calculated in 6.3.9.6.c when about to perform any of the following paragraphs, wait until that time calculated in 6.3.9.6.c has passed and proceed.

Paragraph

6.3.9.15
6.3.9.22
6.3.9.30
6.3.9.36
6.3.9.43
6.3.9.48

6.3.9.8 On K-148 enter the following sequence:

VERB 01 NOUN 01 ENTR
00370 ENTR
Record contents of CRT DSKY Row 1 XXXXY
VERB 21 NOUN 01 ENTR
00370 ENTR
XXXXY' ENTR
Where Y' is obtained from Table V..
VERB 57 ENTR
00001 ENTR
VERB 06 NOUN 61 shall flash

6.3.9.9 On the CRT, DSKY display verify R1 (Navigation Base Azimuth) and R2 (Site Latitude) are correct.

6.3.9.10 If values for R1 and R2 are correct, proceed to next step.

If values for R1 and R2 are incorrect, enter the following sequence into K-148.

VERB 24 ENTR
+XXXX.xx ENTR (Correct navigation base azimuth ± 0.50 deg)
+40.748 ENTR (Correct site latitude)
Verify values in R1 and R2 are correct.

6.3.9.11 On K-148 enter the following sequence:

VERB 33 ENTR
VERB 06 NOUN 66 shall flash

6.3.9.70 Calculations

NOTE: Use Post Vibration or System Test data points only.

6.3.9.70.1 Y PIPA Data Correction Calculation

6.3.9.70.1.1 From the uplink file tape, the compressed data tape or the PCM tape, request a data reduction of the X and Z accelerometer ΔV counts (addresses 37 and 41, respectively) and the TIME 2 and TIME 1 registers (addresses 24 and 25, respectively) for the period during which the Y PIPA test was being performed in positions 5 and 6 of the IMU Performance test.

6.3.9.70.1.2 Perform the following calculations for position 5.

$$G_5' = \frac{G_5}{\cos \theta_{y5}}$$

where:

G_5' = Measured acceleration term (line k)

G_5 = Corrected acceleration term (line k)

$$\cos \theta_{y5} = 1 - \frac{\theta_{y5}^2}{2} \quad (\text{for small angles})$$

where:

$$\theta_{y5} = \sqrt{\theta_{x5}^2 + \theta_{z5}^2}$$

and:

$$\theta_{z5} = \frac{(\Delta V_{z5} - \Delta V_{z5} \text{ Bias}) (S.F._x)}{(\Delta T) (\text{local } g)}$$

$$\theta_{x5} = \frac{(\Delta V_{x5} - \Delta V_{x5} \text{ Bias}) (S.F._z)}{(\Delta T) (\text{local } g)}$$

and:

$$\Delta V_{x5} \text{ Bias} = \frac{(X \text{ PIPA Bias}) (\Delta T)}{S.F._x}$$

$$\Delta V_{z5} \text{ Bias} = \frac{(Z \text{ PIPA Bias}) (\Delta T)}{S.F._z}$$

S.F. and Bias terms are obtained from positions 1 through 4 of the IMU Performance Test.

6.3.9.70.1.3 Perform the following calculations for position 6.

$$G'_6 = \frac{G_6}{\cos \theta_{y6}}$$

where:

G_6 = Measured acceleration term (line 6)

G'_6 = Corrected acceleration term (line 6)

$\cos \theta_{y6} = 1 - \frac{\theta_{x6}^2}{2}$ (for small angles)

$$\theta_{y6} = \sqrt{\theta_{x6}^2 + \theta_{z6}^2}$$

and:

$$\theta_{x6} = \frac{(\Delta V_{x6} - \Delta V_x \text{ Bias}) (S, F, g)}{(\Delta T) (\text{local } g)}$$

$$\theta_{z6} = \frac{(\Delta V_{z6} - \Delta V_z \text{ Bias}) (S, F, g)}{(\Delta T) (\text{local } g)}$$

and:

$$\Delta V_x \text{ Bias} = \frac{(X \text{ PIPA Bias}) (\Delta T)}{S, F, g}$$

$$\Delta V_z \text{ Bias} = \frac{(Z \text{ PIPA Bias}) (\Delta T)}{S, F, g}$$

S, F, and Bias terms are obtained from positions 1 through 4 of the IMU Performance Test.

6.3.9.70 Calculations

NOTE: Use Post Vibration or System Test data points only.

- 6.3.9.70.2 Obtain data from last IRIG and/or PIPA test and fill in Data Sheet x_{1-1} .
- 6.3.9.70.3 Obtain data from second last IRIG and/or PIPA test and fill in Data Sheet x_{1-2} .
- 6.3.9.70.4 Obtain data from third last IRIG and/or PIPA test and fill in Data Sheet x_{1-3} .
- 6.3.9.70.5 Perform the following calculations for each item appearing on Data Sheet x_1 and transfer all results to lines aa through bi.

NOTE:

See paragraph 5.6 before continuing

$$D_1 = |x_{1-1} - x_1|$$

$$D_2 = |x_{1-1} - x_1| + |x_{1-2} - x_{1-1}|$$

$$D_3 = |x_{1-3} - x_{1-2}| + |x_{1-2} - x_{1-1}| + |x_{1-1} - x_1|$$

6.3.10 LGC Voltage Margin Test

6.3.10.1 Initial Conditions

6.3.10.1.1 Insure that the G&N System is in the Standby Mode.

6.3.10.1.2 On the CRT, verify the +25 VDC LGC OPERATE bus is between 24.5 and 33.5 vdc (GG 1530).

6.3.10.1.3 Rotate the ANUN/NUM dimmer control for minimum readable EL brightness. Insure that the ANNUN OVERRIDE switch is OFF.

6.3.10.2 Voltage Margin Determination

6.3.10.2.1 On the PMA Adapter Module (PSAAM) (410-31080), place INHIBIT VOLTAGE FAIL switch to ON.

CAUTION: The +4 vdc LGC Supply voltage shall never be operated lower than +2.5 vdc or higher than +5.2 vdc (GG1030).

The +14 vdc LGC Supply shall never be operated less than +6.5 vdc or higher than +17.0 vdc (GG 1020). LTG-ANUN/NUM Control on panel 5 shall be set to DIM during the performance of the Voltage Margin Test in order to avoid decreasing the operating life of the ~~the~~ DEKTY EL lamps. Indication of the LGC supplies may be disregarded for this test. The charts in Table II may be used to determine approximate values for "XX, X" values

NOTE: ~~That flashing indication of the LGC supplies may be disregarded for this test.~~ The charts in Figure 3 may be used to determine approximate values for "XX, X" values of C-156 voltage dial settings corresponding to various power supply voltages.

DATA SHEET

CALCULATION	PARAMETER	UNITS	
line e - line f = () ---- (-NBDX+ADIA X) - (-NBDX) Transfer result to line al.	ADIA X	meru/g	q
line h - line a = () ---- (+NBDY+ADSRAY) - (+NBDY) Transfer result to al.	ADSRAY	meru/g	r
line j - line c = () ---- (+NBDZ+ADIAZ) - (NBDZ) Transfer result to line am.	ADIAZ	meru/g	s
(line m - line f) X 1.414 = () ---- [(-NBDX + .707 ADSRAX) - (-NBDX)] X 1.414 Transfer result to line ak.	ADSRAX	meru/g	t
(line o + line c) X 1.414 = () ---- (-NBDZ + .707 ADSRAZ + NBDZ) X 1.414 Transfer result to line al.	ADSRAX	meru/g	u
(line p - .707 line a - .707 line f + .5 line q - .5 line t) X2 = ---- [.707 (NBDY-NBDX) + .5 (ADIA Y-ADIA X) + .5 ADSRAX - .707 (-NBDX) - .707 NBDY + .5 ADIA X - .5 ADSRAX] X2 Transfer result to line an.	ADIA Y	meru/g	v
line b - line d = ()	PIPA X2G	cm/sec ²	w
line k - line l = ()	PIPA Y2G	cm/sec ²	x
line g - line i = ()	PIPA Z2G	cm/sec ²	y
1960.52 ÷ line w x 1 cm/sec/pulse = Subtract 1.000000 from this value, multiply x 10 ⁶ and transfer results to line ao.	X PIPA S. F.	cm./sec/ pulse	z
1960.52 ÷ line x X 1 cm/sec/pulse = Subtract 1.000000 from this value, multiply x 10 ⁶ and transfer results to line ap.	Y PIPA S. F.	cm/sec/ pulse	aa
1960.52 ÷ line y X 1 cm/sec/pulse = Subtract 1.000000 from this value, multiply x 10 ⁶ and transfer results to line ao.	Z PIPA S. F.	cm/sec/ pulse	ab
1/2 (line b + line d) = () ---- Transfer results to line ar.	X PIPA Bias	cm/sec ²	ac
1/2 (line k + line l) = () ---- Transfer results to line as	Y PIPA Bias	cm/sec ²	ad
1/2 (line g + line i) = () ---- Transfer results to line at.	Z PIPA Bias	cm/sec ²	ae

TABLE V

Y	Y'
0	2
1	3
2	2
3	3
4	6
5	7
6	6
7	7

DATA SHEET
(x₁)

PARAMETER	UNITS	MIN VALUE	RECORDED VALUE	MAX VALUE	REJ	ACC
NBDY	meru	-15		+15		
NBDZ	meru	-15		+15		
NBDX	meru	-15		+15		
ADSRAY	meru/g	-40		+40		
ADSRAZ	meru/g	-40		+40		
ADSRAX	meru/g	-40		+40		
ADLAX	meru/g	-100		+100		
ADLAZ	meru/g	-100		+100		
ADLAY	meru/g	-100		+100		
X PIPA S. F. error from line z	PPM	-1900		+1900		
Y PIPA S. F. error from line aa	PPM	-1900		+1900		
Z PIPA S. F. error from line ab	PPM	-1900		+1900		
X PIPA Bias from line ac	cm/sec ²	-3.1		+3.1		
Y PIPA Bias from line ad	cm/sec ²	-3.1		+3.1		
Z PIPA Bias from line ae	cm/sec ²	-3.1		+3.1		

af
ag
ah
ai
aj
ak
al
am
an
ao
ap
aq
ar
as
at

6.3.10.2.2 Enter 0001 into R155. Verify and execute.

6.3.10.2.3 Enter 1111 into R154. Verify and execute.

6.3.10.2.4 Enter in C-156 $\pm XX.X001114$. (Enter a value for XX.X which will adjust the +14V power supply (GG 1020) as monitored on the CRT, to 12.1 (+0.1, -0.0) vdc. See Figure 2. Execute.

6.3.10.2.5 Enter in C-156 $\pm XX.X001124$ (Enter a value for XX.X which will adjust the +4V power supply (GG 1030) as monitored on the CRT, to 3.4 (+0.03, -0.00) vdc. See Figure 2. Execute.

6.3.10.2.6 On K-146 press ERROR RESET.

6.3.10.2.7 On K-146 initiate LGC Self-Check by entering the following:

VERB 21 NOUN 27 ENTR
77767 ENTR

Wait 200 seconds. Verify RESTART lamp on the DSKY is not lit.

6.3.10.2.7.1 Into R154 insert 0011. Verify and execute.

6.3.10.2.8 On the PSA Adapter Module place INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on the DSKY is lighted.

6.3.10.2.9 On the PSA Adapter Module place INHIBIT VOLTAGE FAIL switch to ON. Into R-154 insert 1111. Verify and execute. Press ERROR RESET. Perform the following DSKY operations.

VERB 21 NOUN 27 ENTR
77767 ENTR

6.3.10.2.10 Enter in C-156 $\pm XX.X001114$ (Enter a value for XX.X which will adjust the +14V power supply (GG 1020) as monitored on the CRT, to 16.4 (+0.1, -0.0) vdc. See Figure 2. Execute.

6.3.10.2.11 On K-146 press ERROR RESET. Wait 200 seconds. Verify RESTART lamp on DSKY is not lighted.

6.3.10.2.11.1 Into R154 insert 1100. Verify and execute.

6.3.10.2.12 On the PSA Adapter Module place INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on the DSKY is lighted. Set the INHIBIT VOLTAGE FAIL switch to ON. Into R-154 insert 1111. Verify and execute. Press ERROR RESET. Perform the following DSKY operations.

VERB 21 NOUN 27 ENTR
77767 ENTR

6.3.10.2.13 Enter in C-156 \pm XX.X001124 (Enter a value for XX.X which will adjust the 4V power supply (GG 1030) as monitored on the CRT, to 4.6 (+0.02, -0.0) vdc. See Figure 2. Execute.

6.3.10.2.14 On K-148 press ERROR RESET. Wait 200 seconds. Verify RESTART lamp on DSKY is not lit.

6.3.10.2.14.1 Into R154 insert 0011. Verify and execute.

6.3.10.2.15 On the PSA Adapter Module place INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on the DSKY is lit. Set the INHIBIT VOLTAGE FAIL switch to ON. Into R-154, insert 1111. Verify and execute. Press ERROR RESET. Perform the following DSKY operations:

VERB 21 NOUN 27 ENTR
77767 ENTR

6.3.10.2.16 Enter in C-156 \pm XX.X001114 (Enter a value for XX.X which will adjust the 14V power supply (GG 1020) as monitored on the CRT, to 12.1 (+0.1, -0.0) vdc. See Figure 2. Execute.

6.3.10.2.17 On K-148 press ERROR RESET. Wait 200 seconds. Verify RESTART lamp on DSKY is not lighted.

6.3.10.2.17.1 Into R154 insert 1100. Verify and execute.

6.3.10.2.18 On the PSA Adapter Module place INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on the DSKY is lighted.

6.3.10.2.19 On R-154 enter 0000. Execute.

6.3.10.2.20 On R-155 enter 0000. Execute.

6.3.10.2.21 On K-148 terminate the LGC Self-Check by entering the following:

VERB 21 NOUN 27 ENTR
00000 ENTR

6.3.10.2.22 On K-148 press ERROR RESET.

6.3.11 LGC Clock Frequency Test

6.3.11.1 Insure that LGC Operate power has been applied for a minimum of 10 minutes before performing this test.

6.3.11.2 Verify that the counter is connected to the 3.2kc signal on the hardline.

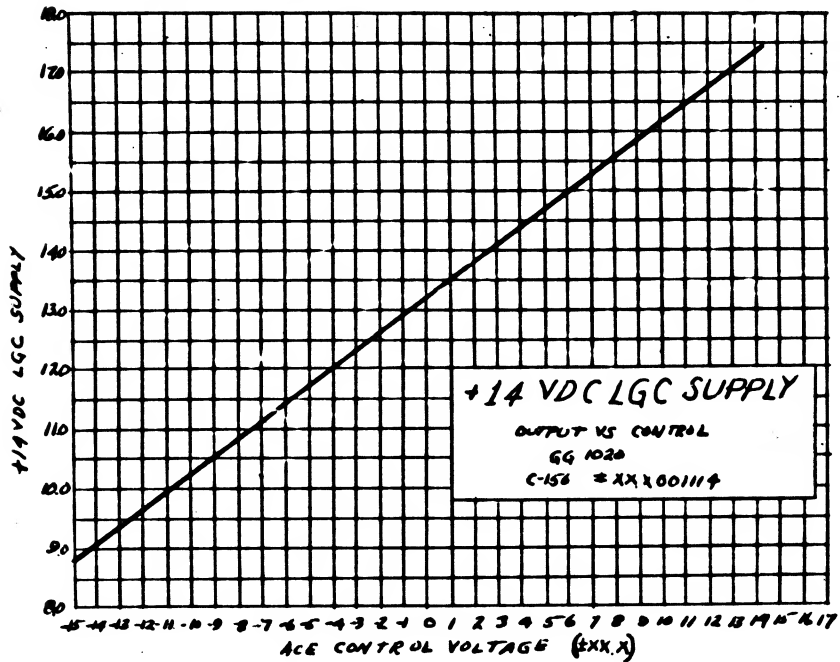
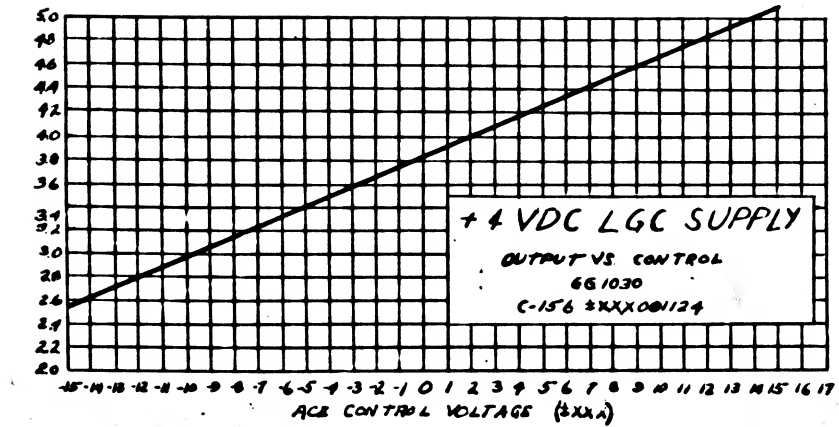


FIGURE 2

6.3.14.8 Verify CRT DSKY display is:

VERB 06 NOUN 61 flashing
R1 = +13500 (SM Azimuth)
R2 = +40748 (Site Latitude)

NOTE: If R1 and R2 indications are correct proceed to step 6.3.14.10.

6.3.14.9 On K-148 enter:

VERB 21 ENTR
+13500 ENTR
VERB 22 ENTR
+40748 ENTR

6.3.14.10 On K-148 enter:

VERB 33 ENTR
Observe on CRT DSKY display
VERB 21 NOUN 30 (Flashing)

6.3.14.11 On K-148 enter:

0000X ENTR (Test position, either 1 or 2)
00000 ENTR (Use AOT)
Observe on CRT DSKY display:
VERB 06 NOUN 61 (Flashing)
Disregard Row 1, 2, and 3 indications

6.3.14.12 On K-148 enter:

VERB 21 ENTR
+XXX,XX ENTR (L tgt. true azimuth) (see 6.3.15.1.14)
VERB 22 ENTR
+XX,XXX ENTR (L tgt. elevation) (see 6.3.15.1.15)
VERB 23 ENTR
00001 ENTR (L tgt. number)
VERB 33 ENTR

Observe on CRT DSKY display:

VERB 06 NOUN 61 (Flashing)

Disregard Row 1, 2 and 3 indications.

6.3.14.13 On K-148 enter:

VERB 21 ENTR
+XXX,XX ENTR (F tgt. true azimuth) (see 6.3.15.1.14)
VERB 22 ENTR
+XX,XXX ENTR (F tgt. elevation) (see 6.3.15.1.15)
VERB 23 ENTR
00002 ENTR (F tgt. number)
VERB 33 ENTR

6.3.15.2 On K-148 enter:

VERB 21	NOUN 03	ENTR
01462		ENTR
XXX.XX		ENTR (Detent L az data)
		ENTR
01463		ENTR
XXX.XX		ENTR (Detent F az data)
		ENTR
01464		ENTR
XXX.XX		ENTR (Detent R az data)
		ENTR
01465		ENTR
XXX.XX		ENTR (Detent L EL data)
		ENTR
01466		ENTR
XXX.XX		ENTR (Detent F EL data)
		ENTR
01467		ENTR
XXX.XX		ENTR (Detent R EL data)

6.3.15.3 Place the AOT in F detent position.

6.3.15.4 While viewing through the AOT instruct the target F operator to translate (vertically and laterally) and rotate (in azimuth and elevation) target F until the center of the target reticle appears at approximately 7.5 degrees in the field of view.

6.3.15.5 Level the Theodolite base while assuring that the center of the target reticle remains at approximately 7.5 degrees in the field of view.

6.3.15.6 When it has been assured that the Theodolite is level, zero the F theodolite azimuth dial.

6.3.15.7 Place the AOT in the L detent position.

6.3.15.8 While viewing through AOT instruct the target L operator to translate (vertically and laterally) and rotate (in azimuth and elevation) target L until the target reticle appears in the lower right quadrant of the AOT field of view.

6.3.15.9 Level the Theodolite base while assuring that the target reticle remains visible in the lower right quadrant of the AOT field of view.

6.3.15.10 When it has been assured that the Theodolite is level and the target reticle is visible, zero the L Theodolite azimuth dial.

6.3.15.11 Place the AOT in the R detent position.

6.3.15.12 While viewing through AOT instruct the target R operator to translate (vertically and laterally) and rotate (in azimuth and elevation) target R until the target reticle appears in the lower left quadrant of the AOT field of view.

6.3.15.13 Level the Theodolite base while assuring that the target reticle remains visible in the lower left quadrant of the AOT field of view.

6.3.15.14 When it has been assured that the Theodolite is level and the target reticle is visible, zero the R theodolite azimuth dial.

6.3.15.15 Verify that target Theodolite L, F and R bases are level. Place the AOT in each Detent positio. from left to right and verify that each target reticle is still visible and in the proper field of view. If adjustments are required insure that the azimuth dial is rezeroed. Repeat this target scanning process until the AOT operator is satisfied with target placement.

6.3.15.16 AOT Measurement of X_1 .

6.3.15.16.1 On K-148 enter:

VERB 57	ENTR
00012	ENTR

Observe VERB 51 flashing and R1 = 00001 on CRT DSKY display.

6.3.15.16.2 On Computer Control and Reticle Dimming Assembly press MARK X pushbutton.

6.3.15.16.3 Observe VERB 21 NOUN 30 flashing on DSKY.

6.3.15.16.4 On DSKY enter:

00000	ENTR
Observe VERB 21	NOUN 43 flashing
00001	ENTR
Observe VERB 21	NOUN 43 flashing

6.3.15.16.5 Set AOT in L detent position.

6.3.15.16.6 Rotate the AOT control knob until the center of the target reticle is superimposed between the double Y reticle. Read and record as LY = XXX.XX.

6.3.15.16.7 Rotate the AOT control knob until the center of the target reticle is superimposed between the double SPRIAL lines of AOT reticle. Record AOT dial indication as LS XXX.XX.

6.3.15.16.8 Record target L Theodolite elevation angle from horizontal as θ_1 .

6.3.15.16.9 On DSKY enter:

▲XXX.XX		ENTR (LY from 6.3.15.16.8)
Observe	VERB 22	NOUN 42 flashing
▲XXX.XX		ENTR (LS from 6.3.15.16.7)
Observe	VERB 51 flashing and R1 = 00002.	

6.3.15.16.10 On Computer Control and Reticle Dimming Assembly, press MARK X pushbutton.

6.3.15.16.11 Observe VERB 21 NOUN 80 flashing on DSKY.

6.3.15.16.12 On DSKY enter:

00000		ENTR
Observe	VERB 21,	NOUN 43 flashing
00002		ENTR
Observe	VERB 21,	NOUN 42 flashing

6.3.15.16.13 Set AOT in F detent position.

6.3.15.16.14 Rotate AOT control knob until the center of the target reticle is superimposed between the double Y reticle. Record AOT dial indication as FY = XXX.XX.

6.3.15.16.15 Rotate the AOT control knob until the center of the target reticle is superimposed between the double S reticle lines. Record AOT dial indication as FS = XXX.XX.

6.3.15.16.16 Record target F Theodolite elevation angle from horizontal as β_2 .

6.3.15.16.17 On DSKY enter:

▲XXX.XX		ENTR (FY from 6.3.15.16.14)
Observe	VERB 22	NOUN 42 flashing
▲XXX.XX		ENTR (FS from 6.3.15.16.15)
Observe	VERB 06	NOUN 03 displayed
Record R1		

6.3.15.17 AOT Measurement of X2.

6.3.15.17.1 On K-148 enter:

VERB 57		ENTR
00012		ENTR
Observe	VERB 51 flashing and R1 = 00001 on CRT DSKY display.	

6.3.15.17.2 On Computer Control and Reticule Dimming Assembly, press MARK X pushbutton.

6.3.15.17.3 Observe VERB 21 NOUN 30 flashing on DSKY.

6.3.15.17.4 On DSKY enter:

00000		ENTR
Observe	VERB 21	NOUN 43 flashing
00001		ENTR
Observe	VERB 21	NOUN 42 flashing
ΔXXX.XX		ENTR (LY from 6.3.15.16.6)
Observe	VERB 22	NOUN 42 flashing
ΔXXX.XX		ENTR (LS from 6.3.15.16.7)
Observe	VERB 51	flashing and R1 = 00002.

6.3.15.17.5 On Computer Control and Reticule Dimming Assembly, press MARK X pushbutton.

6.3.15.17.6 Observe VERB 21, NOUN 30 flashing on DSKY.

6.3.15.17.7 On DSKY enter:

00000		ENTR
Observe	VERB 21	NOUN 43 flashing
00003		ENTR
Observe	VERB 21	NOUN 42 flashing

6.3.15.17.8 Set AOT in R detent position.

6.3.15.17.9 Rotate AOT control knob until the center of the target reticle is superimposed between the double Y reticle. Record AOT dial indication as RY = XXX.XX.

6.3.15.17.10 Rotate AOT control knob until the center of the target reticle is superimposed between the double SPIRAL reticle lines. Record AOT dial indication as RS = XXX.XX.

6.3.15.17.11 Record target R theodolite elevation angle from horizontal as θ_3 .

6.3.15.17.12 On DSKY enter:

ΔXXX.XX		ENTR (RY from 6.3.15.17.9)
Observe	VERB 22	NOUN 42 flashing
ΔXXX.XX		ENTR (RS from 6.3.15.17.10)
Observe	VERB 06	NOUN 08 displayed

Record R1.

6.3.15.18 Theodolite measurement of X_1 and X_2 .

6.3.15.18.1 Collimate Theodolite L and F. Read azimuth angle indicated by L Theodolite. Subtract angle from 360.00° and record as ϕ_1 . Read and record the azimuth angle indicated by F Theodolite as ϕ_2 .

APOLLO G&N Specification
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 Original Issue Date:
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POST-INSTALLATION CHECKOUT SPECIFICATION
 FOR LM G&N SYSTEM

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
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11/27/68	L	37063	7, 24, 35, 60, 76, 81 Total No. pages now 106. <i>LAH/AC</i>	EA	WLS

This specification consists of page 1 to 105 inclusive.

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6.3.2.2.2 Verify RESTART lamp is ON.

6.3.2.2.3 On K-148 enter VERB 36 ENTR. Press ERROR RESET pushbutton. All alarms shall clear.

6.3.2.3 TC Trap Test

6.3.2.3.1 On K-148 enter the following sequence:

VERB 21	NOUN 01	ENTR	14613	ENTR	ENTR
01470		ENTR	00067		ENTR
31474		ENTR	VERB 25	NOUN 26	ENTR
NOUN 15		ENTR	35000		ENTR
54067		ENTR	ENTR	01470	ENTR
31475		ENTR	ENTR	00003	ENTR
54001		ENTR	ENTR	VERB 30	ENTR

6.3.2.3.2 Verify RESTART lamp is ON.

6.3.2.3.3 On K-148 enter VERB 36 ENTR. Press ERROR RESET pushbutton. All alarms shall clear.

6.3.2.3.4 On K-148 enter the following sequence:

VERB 21	NOUN 01	ENTR	22005	ENTR	ENTR
01470		ENTR	01470		ENTR
30067		ENTR	VERB 25	NOUN 26	ENTR
NOUN 15		ENTR	36000		ENTR
31474		ENTR	ENTR	01470	ENTR
22000		ENTR	ENTR	00003	ENTR
			VERB 30		ENTR

6.3.2.3.5 Verify RESTART lamp is ON.

6.3.2.3.6 On K-148 enter VERB 36 ENTR. Press ERROR RESET pushbutton. All alarms shall clear.

6.3.2.4 Nightwatchman Test

6.3.2.4.1 On K-148 enter the following sequence

VERB 24	NOUN 01	ENTR	03400	ENTR
01600	ENTR		01600	ENTR
30001	ENTR		00003	ENTR
01600	ENTR		VERB 30	ENTR
VERB 25	NOUN 26	ENTR		

6.3.2.4.2 Verify RESTART lamp is ON.

6.3.2.4.3 On K-148 enter VERB 36 ENTR. Press ERROR RESET pushbutton. All alarms shall clear.

6.3.7.18 IMU CDU Fine Fail Test

6.3.7.18.1 On K-148 insert the following sequence

+00100 ENTR
+00100 ENTR
+00100 ENTR

On Event Module verify that ISS WARNING lamp lights in approximately 90 seconds.

6.3.7.18.2 After approximately 20 seconds, VERB 01 NOUN 10 shall be displayed. Verify that CRT DSKY display Row 1 indicates 33XXX or 32XXX.

6.3.7.19 IMU CDU Coarse Fail Test

6.3.7.19.1 Enter the following sequence manually per Step 6.3.7.19.1.1.1 or tape load the sequence per Step 6.3.7.19.2.1 and 6.3.7.19.2.2.

6.3.7.19.1.1 Manual Input

6.3.7.19.1.1.1 On K-148, enter

VERB 25 NOUN 26 ENTR
00001 ENTR
01300 ENTR
42005 ENTR
VERB 31 ENTR

6.3.7.19.1.2 Proceed to 6.3.7.19.3 after manual entry of above data.

6.3.7.19.2 Tape loaded input.

6.3.7.19.2.1 Start tape reader at tape section 00102.

6.3.7.19.2.2 When tape reader stops, proceed to next step. See 6.3.7.19.3.

6.3.7.19.3 On K-148, enter the following sequence:

VERB 33 ENTR
Wait for VERB 21 NOUN 22 flashing
+03375 ENTR
+03375 ENTR
+03375 ENTR

On Event Module, verify that ISS Warning Lamp lights in approximately 90 seconds.

6.3.7.19.4 After approximately 20 seconds, VERB 01 NOUN 10 shall be displayed. Verify that CRT DSKY display of Row 1 indicates 33XXX or 32XXX.

6.3.7.20 FDAI Linearity Test

6.3.7.20.1 On K-148, enter the following:

VERB 21 NOUN 01 ENTR
2545 ENTR
1220 ENTR
VERB 33 ENTR
VERB 33 NOUN 27 shall be displayed

DATA SHEET

PARAMETER	UNITS	D ₁	MAX	D ₂	MAX	D ₃	MAX	
NBDY	meru		6.0		9.0		11.0	au
NBDZ	meru		6.0		9.0		11.0	av
NBDX	meru		6.0		9.0		11.0	aw
ADSRAY	meru/g		14.0		21.0		25.0	ax
ADSRAZ	meru/g		14.0		21.0		25.0	ay
ADSRAX	meru/g		14.0		21.0		25.0	az
ADIAX	meru/g		17.0		33.0		40.0	ba
ADIAZ	meru/g		17.0		33.0		40.0	bb
ADIA Y	meru/g		17.0		33.0		40.0	bc
X PIPA S. F.	Error PPM		400		500		600	bd
Y PIPA S. F.	Error PPM		400		500		600	be
Z PIPA S. F.	Error PPM		400		500		600	bf
X PIPA Bias	cm/sec ²		0.50		0.70		0.90	bg
Y PIPA Bias	cm/sec ²		0.50		0.70		0.90	bh
Z PIPA Bias	cm/sec ²		0.50		0.70		0.90	bi

6.3.12.4 Test Analysis

6.3.12.4.1 Remove the strip charts from analog recorders

6.3.12.4.2 Examine the traces of the recorded measurements for all six phases of this test to detect any sharp discontinuities. Disregard transients of 0.5 second duration or less on the Gimbal Torque Motor current traces and disregard all transients on the CDU Fine Error and CDU Coarse Error traces. The Gimbal Torque Motor currents shall not exceed 0.125 amperes. The CDU Fine Error measurements shall not exceed ± 70 mv rms. The CDU Coarse Error measurement shall not exceed ± 680 mv rms.

6.3.13 Stabilization Loop Step Response Test

6.3.13.1 IG Response Test

6.3.13.1.1 On K-148 enter the following sequence:

```
VERB 40 NOUN 20 ENTR Wait 3 seconds
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR
```

6.3.13.1.2 On CRT, verify IG MG, and OG gimbal angles are between 358 and 002.

6.3.13.1.3 Set up analog recorder to monitor the following:

MEAS NO:	SIGNAL NAME
a. GG2110	IG Torque Motor Current
b. GG2106	IG Servo Error Total
c. GG2107	IG Servo Error In Phase
d. GG2112	IG 1X Resolver Sine
e. GG2113	IG 1X Resolver Cosine
f. GG2220	IG CDU Fine Error
g. GG1201	IMU 28V 1 PCT 800 CPS

6.3.13.1.4 On K-148 initiate FINE ALIGN by entering the following sequence:

```
VERB 42 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR
```

6.3.14.8 Verify CRT DSKY display is:

VERB 06 NOUN 61 flashing
R1 = +13500 (SM Azimuth)
R2 = +40748 (Site Latitude)

NOTE: If R1 and R2 indications are correct proceed to step 6.3.14.10.

6.3.14.9 On K-148 enter:

VERB 21 ENTR
+13500 ENTR
VERB 22 ENTR
+40748 ENTR

6.3.14.10 On K-148 enter:

VERB 33 ENTR
Observe on CRT DSKY display
VERB 21 NOUN 30 (Flashing)

6.3.14.11 On K-148 enter:

0000X ENTR (Test position, either 1 or 2)
00000 ENTR (Use AOT)

Observe on CRT DSKY display:

VERB 06 NOUN 61 (Flashing)

Disregard Row 1, 2, and 3 indications

6.3.14.12 On K-148 enter:

VERB 21 ENTR
+XXX,XX ENTR (L tgt. true azimuth) (see 6.3.14.10.1)
VERB 22 ENTR
+XX,XXX ENTR (L tgt. elevation) (see 6.3.14.10.1)
VERB 23 ENTR
00001 ENTR (L tgt. number)
VERB 33 ENTR

Observe on CRT DSKY display:

VERB 06 NOUN 61 (Flashing)

Disregard Row 1, 2 and 3 indications.

6.3.14.13 On K-148 enter:

VERB 21 ENTR
+XXX,XX ENTR (F tgt. true azimuth) (see 6.3.14.10.1)
VERB 22 ENTR
+XX,XXX ENTR (F tgt. elevation) (see 6.3.14.10.1)
VERB 23 ENTR
00002 ENTR (F tgt. number)
VERB 33 ENTR

APOLLO G&N Specification
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POST-INSTALLATION CHECKOUT SPECIFICATION
 FOR LM G&N SYSTEM

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
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11/27/68	L	37063	7, 24, 35, 60, 76, 81 Total No. pages now 106. <i>WLS</i>	EA	WLS
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This specification consists of page 1 to 109 inclusive.

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6.2.4.10 CAUTION: LGC OPERATE AND IMU STANDBY power must have been applied a minimum of two hours before energizing the IMU OPERATE circuit breaker in step 6.2.4.16 unless all of the following conditions are met:

- IF: 1. The G&N System has previously been in Standby Mode at least two hours and subsequently been in Operate Mode, AND
2. The gimbals were placed in a parked position prior to shutdown, AND
3. The shutdown period did not exceed 12 days and the gimbals were parked at:
- 0° ± 1°
- AND: 90° ± 1° AND
4. The Spacecraft or IMU have not been moved in any way during the shutdown period.

THEN: The two-hour standby Mode operation requirement is reduced to 15 minutes.

6.3.1.6.2 Lamp Test

6.3.1.6.2.1 Initiate the Lamp Test by entering in the DSKY:

VERB 35 ENTR

6.3.1.6.2.2 The following DSKY displays shall illuminate for approximately 5 seconds. On CAUTION/WARNING panel, the following displays shall illuminate, then extinguish:

LGC
ISS

- a. UP LINK ACTY
- b. NO ATT
- c. STBY
- d. KEY REL flashing
- e. TEMP
- f. GIMBAL LOCK
- g. PROG
- h. RESTART
- i. TRACKER
- j. OPR ERROR Flashing
- k. VERB-NOUN Flashing
- l. Plus 88888 in Row 1,
Row 2, and Row 3

On concurrently for approximately 5 seconds.

8's remain in the VERB NOUN display

+8's remain in DSKY Row 1, 2 and 3 display

6.3.1.6.2.3 On K-148 enter:

VERB 21 NOUN 01 ENTR

00322 ENTR

40004 ENTR

On the DSKY verify "VEL" light is on.

6.3.1.6.2.3.1 On K-148 enter:

PRESS ENTR

00322 ENTR

40020 ENTR

On the DSKY verify "ALT" light is on and "VEL" light is off.

6.3.1.6.2.3.2 On K-148 enter:

PRESS ENTR

00322 ENTR

40000 ENTR

On the DSKY verify "ALT" and "VEL" lights are off.

6.3.1.6.3 Uplink Check

6.3.1.6.3.1 On K-START 148; set LOAD/INHIBIT switch to LOAD, set TAPE/KEY switch to KEY, then enter the following:

ERROR RESET
VERB 25 NOUN 01 ENTR
02400 ENTR
+01234 ENTR
-56789 ENTR
+00000 ENTR

6.3.1.6.3.2 Verify the following is displayed on the DSKY.

VERB 23 NOUN 01
R1 + 01234
R2 - 56789
R3 + 00000

6.3.1.6.4 Downlink Check

6.3.1.6.4.1 On CRT, DSKY display, verify the following is displayed:

VERB 23 NOUN 01
R1 + 01234
R2 - 56789
R3 + 00000

6.3.1.6.5 LGC Self-Check

6.3.1.6.5.1 On K-148 enter the following sequence:

1. ERROR RSET
2. VERB 36 ENTR
3. VERB 21 NOUN 01 ENTR
4. 01362 ENTR
5. 00000 ENTR ENTR
6. 01365 ENTR
7. 00000 ENTR
8. NOUN 15 ENTR
9. 00000 ENTR ENTR
10. 00000 ENTR ENTR
11. 00000 ENTR
12. Verify REDO Counter = +00000
13. VERB 21 NOUN 27 ENTR
14. 00010 ENTR
15. VERB 15 NOUN 01 ENTR
16. 01366 ENTR

6.3.1.6.5.2 On the CRT, DSKY display, verify that R1 does not display 01102 or 41102. If a malfunction occurs, the following is displayed:

R1 01102 or 41102
R2 XXXXX c (S FAIL) program address +1 of point failure
R3 XXXXX number of fails.

6.3.1.6.5.3 When R3 = 00002, stop the LGC Self Check by entering the K-148 in the following:

VERB 34 ENTR
VERB 21 NOUN 27 ENTR
00000 ENTR

6.3.1.6.6 LGC Standby Check

6.3.1.6.6.1 On K-148, enter the following sequence:

VERB 21 NOUN 17 ENTR
+00000 ENTR

Start ACE Countdown clock upon depressing ENTR from an initial setting of 0 HRS, 0 MIN, 0 SEC. Record difference between LGC time on the CRT and the Countdown clock.

VERB 60 ENTR
Verify on CRT ABL-LGC-STBY is ON

6.3.1.6.6.2 On DSKY depress PRO pushbutton for approximately 3 seconds.

6.3.1.6.6.3 Verify STBY status indicator lamp is ON.

6.3.1.6.6.4 On the CRT, verify the 3.2 KC 28V Supply (GG1331) is between 28.04 and 29.16V RMS.

6.3.1.6.6.5 On DSKY depress PRO pushbutton for approximately 3 seconds to return to LGC OPERATE mode. If the LGC does not return to the OPERATE mode, depress the PRO pushbutton for a maximum of two additional times.

6.3.8.19 In approximately 200 seconds, VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (+Z IRIG Scale Factor error in parts per million, Position -00003).

6.3.8.20 Repeat steps 6.3.8.8 through 6.3.8.19 twice to obtain second and third set of data.

6.3.8.21 Terminate this test by entering in K-148 the following:

VERB 34 ENTR
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR

6.3.8.22 The average of the three readings of Scale Factor Error for each of the 6 positions shall be 0 ± 1750 PPM.

6.3.9 IMU Performance Test. A reference data sheet is provided at the end of this section to aid in data reduction.

6.3.9.1 Insure that IMU Operate power and LGC Operate power has been applied for a minimum of one hour and that the IMU is not in a Gimbal Lock condition.

6.3.9.2 On CRT display, monitor and record IRIG TEMP (GG2301) and PIPA TEMP (GG2300).

6.3.9.3 Adjust oscilloscope to display butterfly of X PIPA.

6.3.9.4 On K-148 enter the following:

VERB 01 NOUN 10 ENTR
00003 ENTR

Record CRT DSKY Row 1 indication AAAAA and the time of day.

6.3.9.5 On K-148 enter the following:

VERB 21 NOUN 01 ENTR
01300 ENTR
AAAAA ENTR
VERB 06 NOUN 02 ENTR
01300 ENTR

Record CRT DSKY Row 1 indications as ±BBBBB.

6.3.9.6 Perform the following calculations:

(a) $\frac{BBBBB \times 5.12}{3600} = CCCC.C$ (Contents (hrs) of high order scalar register.)

(b) $23.3 - CCCC.C = DDDD.D$ hours.

- (c) DDDD, D + present time of day = time of day at which high order scalar register will overflow.

6.3.9.7 If the time of day is within 12 minutes of that calculated in 6.3.9.6, c when about to perform any of the following paragraphs, wait until that time calculated in 6.3.9.6, c has passed and proceed.

Paragraph

6.3.9.15

6.3.9.22

6.3.9.30

6.3.9.36

6.3.9.43

6.3.9.48

6.3.9.8 On K-148 enter the following sequence:

VERB 01 NOUN 01 ENTR
00370 ENTR

Record contents of CRT DSKY Row 1 XXXXY

VERB 21 NOUN 01 ENTR
00370 ENTR
XXXXY' ENTR

Where Y' is obtained from Table 1a.

6.3.9.8.1 Verify K-Start Tape G03L006-K10544-00 is on the K-START tape reader.

6.3.9.8.2 Start K-START tape reader.

6.3.9.8.3 When tape reader stops verify on the CRT DSKY display:

R1 = +03088
R2 = +10544
R3 = -00000

6.3.9.8.4 Start tape reader.

6.3.9.8.5 When tape reader stops verify the following on the CRT DSKY display:

R1 = 00101

6.3.9.8.6 On K-148 enter the following sequence:

VERB 57 ENTR
00001 ENTR
VERB 06 NOUN 61 shall flash

NOTE

1. If PROG ALARM comes on during the performance of this test with FAIL REG equal 2001, reset and continue. Error Code 2001 indicates a rate calculation overflow in the CDU Least Squares fit routine and does not affect results of IMU Performance Test

6.3.9.9 On the CRT DSKY display verify R1 (Navigation Base Azimuth) and R2 (Site Latitude) are correct.

6.3.9.10 If values for R1 and R2 are correct, proceed to next step. If values for R1 and R2 are incorrect, enter the following sequence into K-148:

VERB 24	ENTR
+XXX.XX	ENTR (Correct navigation base azimuth $\pm .50^\circ$)
+40.748	ENTR (Correct site latitude)

Verify values in R1 and R2 are correct.

6.3.9.11 On K-148 enter the following sequence:

VERB 33	ENTR
VERB 06 NOUN 66	shall flash

6.3.9.12 On CRT DSKY display, verify R1 = +00600 (Time), R2 = +00000 (Test Index No.) and R3 = +00001 (Test Position). If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25	ENTR
+00600	ENTR (Test Time in Seconds)
+00000	ENTR (Test Index Number)
+00001	ENTR (Test Position Entry)

6.3.9.13 On K-148 enter the following sequence, after the NO ATT light extinguishes:

VERB 33	ENTR
VERB 25 NOUN 26	ENTR
00144	ENTR
01111	ENTR
02006	ENTR
VERB 31	ENTR

6.3.9.14 In approximately 12 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (+NBDY Position +00001).

6.3.9.14.1 Enter the following on the CRT DSKY:

VERB 07 NOUN 01	ENTR
03223	ENTR

Record R1 and R2 (Outer Gimbal Rate)

Press	ENTR
03225	ENTR

Record R1 and R2 (Inner Gimbal Rate)

Press	ENTR
03227	ENTR

Record R1 and R2 (Middle Gimbal Rate)

6.3.9.15 On K-148 enter the following sequence:

VERB 33	ENTR
---------	------

6.3.9.16 Deleted.

6.3.9.17 In approximately 5 minutes, VERB 06 NOUN 66 shall flash. From the CRT, record R1 and R2 (+X PIPA Position +00001). Row 1 is whole part, Row 2 is fractional part. Units are cm/sec².

6.3.9.18 On K-148 enter the following sequence:

VERB 34	ENTR
VERB 06 NOUN 66 shall flash	

6.3.9.19 On CRT DSKY display, verify R1 = +00600, R2 = +00000, and R3 = +00002.

6.3.9.20 On K-148 enter the following sequence:

VERB 33	ENTR
VERB 31	ENTR

6.3.9.21 In approximately 12 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (+NBDZ Position +00002).

6.3.9.21.1 Enter the following on the CRT DSKY:

VERB 07 NOUN 01	ENTR
03223	ENTR

Record R1 and R2 (Outer Gimbal Rate)

Press	ENTR
03225	ENTR

Record R1 and R2 (Inner Gimbal Rate)

Press	ENTR
03227	ENTR

Record R1 and R2 (Middle Gimbal Rate)

6.3.9.22 On K-148 enter the following sequence:

VERB 33 ENTR

6.3.9.23 In approximately 5 minutes VERB 06 NOUN 66 shall flash. From the CRT, record R1 and R2 (-X PIPA position +00002).

6.3.9.24 On K-148 enter the following sequence, after the NO ATT light extinguishes:

VERB 33 ENTR
VERB 25 NOUN 26 ENTR
00144 ENTR
01121 ENTR
02006 ENTR
VERB 31 ENTR

6.3.9.24.1 In 10 minutes enter the following on K-148:

VERB 16 NOUN 02 ENTR
03212 ENTR

When R1' = +00030 perform the following:

VERB 34 ENTR
VERB 07 NOUN 01 ENTR
03223 ENTR

Record R1 and R2 (Outer Gimbal Rate)

Press ENTR
03225 ENTR

Record R1 and R2 (Inner Gimbal Rate)

Press ENTR
03227 ENTR

Record R1 and R2 (Middle Gimbal Rate)

VERB 31 ENTR

6.3.9.24.2 Repeat above step 4 times.

6.3.9.25 Approximately 67 minutes after performing VERB 33 above, VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R2 (-NBDX + ADIAX Pos +00002).

6.3.9.26 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.3.9.27 On CRT DSKY display verify R1 = +00600, R2 = +00000, and R3 = +00003.

6.3.9.28 On K-148 enter the following sequence, after the NO ATT light extinguishes:

VERB 33 ENTR
VERB 25 NOUN 26 ENTR
00144 ENTR
01111 ENTR
02006 ENTR
VERB 31 ENTR

6.3.9.29 In approximately 12 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY record R2 (-NBDX Position +00003).

6.3.9.29.1 Enter the following on the CRT DSKY:

VERB 07 NOUN 01 ENTR
03223 ENTR

Record R1 and R2 (Outer Gimbal Rate)

Press ENTR
03225 ENTR

Record R1 and R2 (Inner Gimbal Rate)

Press ENTR
03227 ENTR

Record R1 and R2 (Middle Gimbal Rate)

6.3.9.30 On K-148 enter the following sequence:

VERB 33 ENTR

6.3.9.31 In approximately 5 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R1 and R2 (+Z PIPA Position +00003).

6.3.9.32 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.3.9.33 On the CRT DSKY display verify R1 = +00600, R2 = 00000, and R3 = +00004.

6.3.9.34 On K-148 enter the following sequence:

VERB 33	ENTR
VERB 31	ENTR

6.3.9.35 In approximately 12 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R2 (+NBDY + ADSRAY Position +00004).

6.3.9.35.1 Enter the following on the CRT DSKY:

VERB 07 NOUN 01	ENTR
03223	ENTR

Record R1 and R2 (Outer Gimbal Rate)

Press	ENTR
03225	ENTR

Record R1 and R2 (Inner Gimbal Rate)

Press	ENTR
03227	ENTR

Record R1 and R2 (Middle Gimbal Rate)

6.3.9.36 On K-148 enter the following sequence:

VERB 33	ENTR
---------	------

6.3.9.37 Deleted.

6.3.9.38 In approximately 5 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R1 and R2 (-Z PIPA Position +00004).

6.3.9.39 On K-148 enter the following sequence, after the NO ATT light extinguishes:

VERB 33	ENTR
VERB 25 NOUN 26	ENTR
00144	ENTR
01121	ENTR
02006	ENTR
VERB 31	ENTR

6.3.9.39.1 In 10 minutes, enter the following on K-148:

VERB 16 NOUN 02	ENTR
03212	ENTR

When R1 = +00030, perform the following:

VERB 34 ENTR
VERB 07 NOUN 01 ENTR
03223 ENTR

Record R1 and R2 (Outer Gimbal Rate)

Press ENTR
03225 ENTR

Record R1 and R2 (Inner Gimbal Rate)

Press ENTR
03227 ENTR

Record R1 and R2 (Middle Gimbal Rate)

VERB 31 ENTR

6.3.9.39.2 Repeat above step 4 times.

6.3.9.40 Approximately 87 minutes after performing VERB 33 above, VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R2 (+NBDZ + ADIAZ Position +00004).

6.3.9.41 On K-148 enter the following sequence:

VERB 33 ENTR
VERB 06 NOUN 66 shall flash

6.3.9.42 From the CRT DSKY display verify R1 = +00600, R2 = +00000, and R3 = +00005.

6.3.9.43 Record time. On K-148 enter the following sequence:

VERB 33 ENTR

6.3.9.44 The PROG ALARM and GIMBAL LOCK lamps shall light. Press Error Reset. The GIMBAL LOCK lamp shall remain lit.

6.3.9.45 In approximately 5 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R1 and R2 (+Y PIPA Position +00005). Correct measured g term per Paragraph 6.3.9.70.1 and transfer results to line k.

6.3.9.46 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.3.9.47 On the CRT DSKY display verify R1 = +00600, R2 = +00000 and R3 = +00006.

6.3.9.48 Record time. On K-148 enter the following sequence:

VERB 33 ENTR

6.3.9.49 Verify the PROG ALARM and GIMBAL LOCK lamps are lit. Press Error Reset. The GIMBAL LOCK lamp may remain lit until Paragraph 6.3.9.53 is performed.

6.3.9.50 In approximately 5 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R1 and R2. (-Y PIPA Position +00006). Correct measured g term per Paragraph 6.3.9.70.1 and transfer results to line 1.

6.3.9.51 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.3.9.52 On the CRT DSKY display verify R1 = +00600, R2 = +00000 and R3 = +00007.

6.3.9.53 On K-148 enter the following sequence, after the NO ATT light extinguishes:

VERB 33 ENTR
VERB 25 NOUN 26 ENTR
00144 ENTR
01111 ENTR
02006 ENTR
VERB 31 ENTR

6.3.9.54 In approximately 12 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R2 (+.707 ADSRAX - NBDX Position +00007).

6.3.9.54.1 Enter the following on the CRT DSKY.

VERB 07 NOUN 01 ENTR
03223 ENTR

Record R1 and R2 (Outer Gimbal Rate)

Press ENTR
03225 ENTR

Record R1 and R2 (Inner Gimbal Rate)

Press ENTR
03227 ENTR

Record R1 and R2 (Middle Gimbal Rate)

6.3.9.55 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.3.9.56 On the CRT display verify $R1 = +00600$, $R2 = +00000$ and $R3 = +00008$.

6.3.9.57 On K-148 enter the following sequence, after the NO ATT light extinguishes:

VERB 33 ENTR
VERB 31 ENTR

6.3.9.58 In approximately 12 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display record $R2 [-.707 (NBDZ + NBDY) +0.5 (ADIAZ - ADIAY) +0.5 (ADSRAZ + ADSRAZ)]$ (Position +00009),

6.3.9.58.1 Enter the following on the CRT DSKY:

VERB 07 NOUN 01 ENTR
03223 ENTR

Record R1 and R2 (Outer Gimbal Rate)

Press ENTR
03225 ENTR

Record R1 and R2 (Inner Gimbal Rate)

Press ENTR
03227 ENTR

Record R1 and R2 (Middle Gimbal Rate)

6.3.9.59 On K-148 enter the following:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.3.9.60 On the CRT DSKY display verify $R1 = +00600$, $R2 = +00000$ and $R3 = +00009$.

6.3.9.61 On K-148 enter the following sequence, after the NO ATT light extinguishes.

VERB 33 ENTR
VERB 31 ENTR

6.3.9.62 In approximately 12 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display record $R2 (-NBDZ +.707 ADSRAZ$ Position +00009).

6.3.9.62.1 Enter the following on the CRT DSKY:

VERB 07 NOUN 01 ENTR
03223 ENTR

Record R1 and R2 (Outer Gimbal Rate)

Press ENTR
03225 ENTR

Record R1 and R2 (Inner Gimbal Rate)

Press ENTR
03227 ENTR

Record R1 and R2 (Middle Gimbal Rate)

6.3.9.63 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.3.9.64 On the CRT DSKY display verify R1 = +00600, R2 = +00000 and R3 = +00010.

6.3.9.65 On K-148 enter the following sequence, after the NO ATT light extinguishes

VERB33 ENTR
VERB 31 ENTR

6.3.9.66 In approximately 12 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R2 [.707 (NBDY-NBDX) +.5 (ADIAY - ADIAX) +.5 ADSRAX] (Position +00010).

6.3.9.66.1 Enter the following on the CRT DSKY:

VERB 07 NOUN 01 ENTR
03223 ENTR

Record R1 and R2 (Outer Gimbal Rate)

Press ENTR
03225 ENTR

Record R1 and R2 (Inner Gimbal Rate)

Press ENTR
03227 ENTR

Record R1 and R2 (Middle Gimbal Rate)

6.3.9.67 Terminate this test by entering in K-148 the following:

VERB 36 ENTR

6.3.9.68 On CRT record IRIG TEMP (CG2301) and PIPA TEMP (CG2300).

6.3.9.69 On K-148 enter the following sequence:

VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR

6.3.9.70 Calculations

NOTE: Use Post Vibration or System Test data points only.

6.3.9.70.1 Y PIPA Data Correction Calculation

6.3.9.70.1.1 From the uplink file tape, the compressed data tape or the PCM tape, request a data reduction of the X and Z accelerometer ΔV counts (addresses 37 and 41, respectively) and the TIME 2 and TIME 1 registers (addresses 24 and 25, respectively) for the period during which the Y PIPA test was being performed in positions 5 and 6 of the IMU Performance test.

6.3.9.70.1.2 Perform the following calculations for position 5.

$$G_5' = \frac{G_5}{\cos \theta y_5}$$

where:

G_5' = Measured acceleration term

G_5 = Corrected acceleration term (line k)

$$\cos \theta y_5 = 1 - \frac{\theta^2 y_5}{2} \text{ (for small angles)}$$

where:

$$\theta y_5 = \sqrt{\theta^2 x_5 + \theta^2 z_5}$$

and:

$$\theta z_5 = \frac{(\Delta V_{z5} - \Delta V_z \text{ Bias}) (S.F._z)}{(\Delta T) (\text{local } g)}$$

$$\theta x_5 = \frac{(\Delta V_{x5} - \Delta V_x \text{ Bias}) (S.F._x)}{(\Delta T) (\text{local } g)}$$

and:

$$\Delta V_x \text{ Bias} = \frac{(X \text{ PIPA Bias}) (\Delta T)}{S.F._x}$$

$$\Delta V_z \text{ Bias} = \frac{(Z \text{ PIPA Bias}) (\Delta T)}{S.F._z}$$

S.F. and Bias terms are obtained from positions 1 through 4 of the IMU Performance Test.

6.3.9.70.1.3 Perform the following calculations for position 6.

$$G'_6 = \frac{G_6}{\cos \theta y_6}$$

where:

G_6 = Measured acceleration term

G'_6 = Corrected acceleration term (line 6)

$$\cos \theta y_6 = 1 - \frac{\theta^2 y_6}{2} \text{ (for small angles)}$$

$$\theta y_6 = \sqrt{\theta^2 x_6 + \theta^2 z_6}$$

and:

$$\theta z_6 = \frac{(\Delta V x_6 - \Delta V x \text{ Bias}) (S.F. x)}{(\Delta T) (\text{local } g)}$$

$$\theta x_6 = \frac{(\Delta V z_6 - \Delta V z \text{ Bias}) (S.F. z)}{(\Delta T) (\text{local } g)}$$

and:

$$\Delta V_x \text{ Bias} = \frac{(X \text{ PIPA Bias}) (\Delta T)}{S.F. x}$$

$$\Delta V_z \text{ Bias} = \frac{(Z \text{ PIPA Bias}) (\Delta T)}{S.F. z}$$

S.F. and Bias terms are obtained from positions 1 through 4 of the IMU Performance Test.

6.3.9.70 Calculations

NOTE: Use Post Vibration or System Test data points only.

- 6.3.9.70.2 Obtain data from last IRIG and/or PIPA test and fill in Data Sheet x_{i-1} .
- 6.3.9.70.3 Obtain data from second last IRIG and/or PIPA test and fill in Data Sheet x_{i-2} .
- 6.3.9.70.4 Obtain data from third last IRIG and/or PIPA test and fill in Data Sheet x_{i-3} .
- 6.3.9.70.5 Perform the following calculations for each item appearing on Data Sheet x_i and transfer all results to lines au through bi.

NOTE:

See paragraph 5.6 before continuing

$$D_1 = |x_{i-1} - x_i|$$

$$D_2 = |x_{i-1} - x_i| + |x_{i-2} - x_{i-1}|$$

$$D_3 = |x_{i-3} - x_{i-2}| + |x_{i-2} - x_{i-1}| + |x_{i-1} - x_i|$$

6.3.10 LGC Voltage Margin Test

6.3.10.1 Initial Conditions

6.3.10.1.1 Insure that the G&N System is in the Standby Mode.

6.3.10.1.2 On the CRT, verify the +28 VDC LGC OPERATE bus is between 24.5 and 33.5 vdc (GG 1520).

6.3.10.1.3 Rotate the ANUN/NUM dimmer control for minimum readable EL brightness. Insure that the ANNUN OVERRIDE switch is OFF.

6.3.10.2 Voltage Margin Determination

6.3.10.2.1 On the PSA Adapter Module (PSAAM) (410-31080), place INHIBIT VOLTAGE FAIL switch to ON.

CAUTION: The +4 vdc LGC Supply voltage shall never be operated lower than +2.5 vdc or higher than +5.2 vdc (GG1030).

The +14 vdc LGC Supply shall never be operated less than +8.5 vdc or higher than +17.0 vdc (GG 1020). LTG-ANUN/NUM Control on panel 5 shall be set to DIM during the performance of the Voltage Margin Test in order to avoid decreasing the operating life of the DSKY EL lamps. Indication of the LGC supplies may be disregarded for this test.

The charts in Table II may be used to determine approximate values for "XX, X" values

NOTE: The flashing indication of the LGC supplies may be disregarded for this test. The charts in Figure 2 may be used to determine approximate values for "XX, X" values of C-156 voltage dial settings corresponding to various power supply voltages.

DATA SHEET

ITEM NO.	PARAMETER	UNITS	RECORDED VALUE
6.3.9.14	+N BDY Position +00001 Transfer result to line af	meru	() ---. --
6.3.9.17	+X PIPA Test Position +00001	cm/sec ²	() 00---. () --
6.3.9.21	+N BDZ Position +00002 Transfer result to line ag	meru	() ---. --
6.3.9.23	-X PIPA Test Position +00002	cm/sec ²	() 00---. () ----
6.3.9.25	-N BDX + ADIAX Position +00002	meru	() ---. --
6.3.9.29	-N BDX Position +00003 Multiply by -1 and transfer result to line ah	meru	() ---. --
6.3.9.31	+Z PIPA Test Position +00003	cm/sec ²	() 00---. () ----
6.3.9.35	+N BDY + ADSRAY Position +00004	meru	() ---. --
6.3.9.38	-Z PIPA Test Position +00004	cm/sec ²	() 00---. () ----
6.3.9.40	+N BDZ + ADIAZ Position +00004	meru	() ---. --
6.3.9.45	+Y PIPA Test Position +00005	cm/sec ²	() 00---. () ----
6.3.9.50	-Y PIPA Test Position +00006	cm/sec ²	() 00---. () ----

a.

b.

c.

d.

e.

f.

g.

h.

i.

j.

k.

l.

DATA SHEET

ITEM NO.	PARAMETER	UNITS	RECORDED VALUE
6.3.9.54	-NBDX+ .707 ADSRAX Position +00007	meru	
6.3.9.58	-.707 (NBDZ+NBDY) +0.5 (ADIAZ-ADIA Y) +0.5 (ADSRAY+ADSRAX) Position +00008	meru	
6.3.9.62	-NBDZ+.707ADSRAX Position +00009	meru	
6.3.9.66	.707(NBDY-NBDX) +.5 (ADIA Y-ADIA X) +.5 ADSRAX Position +00010	meru	

m.

n.

o.

p.

DATA SHEET

CALCULATION	PARAMETER	UNITS	
line e - line f = () ---.-- (-NBDX+ADIAX) - (-NBDX) Transfer result to line al.	ADIAX	meru/g	q
line h - line a = () ---.-- (+NBDY+ADSRAY) - (+NBDY) Transfer result to al.	ADSRAY	meru/g	r
line j - line c = () ---.-- (+NBDZ+ADIAZ) - (NBDZ) Transfer result to line am.	ADIAZ	meru/g	s
(line m - line f) X 1.414 = () ---.-- [(-NBDX + .707 ADSRAX) - (-NBDX)] X 1.414 Transfer result to line ak.	ADSRAX	meru/g	t
(line o + line c) X 1.414 = () ---.-- (-NBDZ + .707 ADSRAZ + NBDZ) X 1.414 Transfer result to line al.	ADSRAX	meru/g	u
(line p - .707 line a - .707 line f + .5 line q - .5 line t) X2 = ---.-- [.707 (NBDY-NBDX) + .5 (ADIAY-ADIAX) + .5 ADSRAX -.707 (-NBDX) -.707 NBDY + .5 ADIAZ -.5 ADSRAX] X2 Transfer result to line an.	ADIAY	meru/g	v
line b - line d = ()	PIPA X2G	cm/sec ²	w
line k - line l = ()	PIPA Y2G	cm/sec ²	x
line g - line i = ()	PIPA Z2G	cm/sec ²	y
1960.52 ÷ line w x 1 cm/sec/pulse = Subtract 1.000000 from this value, multiply x 10 ⁶ and transfer results to line ao.	X PIPA S. F.	cm/sec/ pulse	z
1960.52 ÷ line x X 1 cm/sec/pulse = Subtract 1.000000 from this value, multiply x 10 ⁶ and transfer results to line ap.	Y PIPA S. F.	cm/sec/ pulse	aa
1960.52 ÷ line y X 1 cm/sec/pulse = Subtract 1.000000 from this value, multiply x 10 ⁶ and transfer results to line aq.	Z PIPA S. F.	cm/sec/ pulse	ab
1/2 (line b + line d) = () ---.-- Transfer results to line ar	X PIPA Bias	cm/sec ²	ac
1/2 (line k + line l) = () ---.-- Transfer results to line as	Y PIPA Bias	cm/sec ²	ad
1/2 (line g + line i) = () ---.-- Transfer results to line at	Z PIPA Bias	cm/sec ²	ae

TABLE V

Y	Y'
0	2
1	3
2	2
3	3
4	6
5	7
6	6
7	7

DATA SHEET
(x_i)

PARAMETER	UNITS	MIN VALUE	RECORDED VALUE	MAX VALUE	REJ	ACC
NBDY	meru	-15		+15		
NBDZ	meru	-15		+15		
NBDX	meru	-15		+15		
ADSRAY	meru/g	-40		+40		
ADSRAX	meru/g	-40		+40		
ADSRZ	meru/g	-40		+40		
ADIAZ	meru/g	-100		+100		
ADIAZ	meru/g	-100		+100		
ADIAZ	meru/g	-100		+100		
X PIPA S. F. error from line z	PPM	-1900		+1900		
Y PIPA S. F. error from line aa	PPM	-1900		+1900		
Z PIPA S. F. error from line ab	PPM	-1900		+1900		
X PIPA Bias from line ac	cm/sec ²	-3.1		+3.1		
Y PIPA Bias from line ad	cm/sec ²	-3.1		+3.1		
Z PIPA Bias from line ae	cm/sec ²	-3.1		+3.1		

af
ag
ah
ai
aj
ah
ai
am
an
ao
ap
aq
ar
as
at

DATA SHEET
(x1-1)

PARAMETER	UNITS	RECORDED VALUE
NBDY	meru	
NBDZ	meru	
NBDX	meru	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADSRAX	meru/g	
ADIAX	meru/g	
ADIAZ	meru/g	
ADIAZ	meru/g	
X PIPA S. F. error	PPM	
Y PIPA S. F. error	PPM	
Z PIPA S. F. error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

DATA SHEET
(x₁-2)

PARAMETER	UNITS	RECORDED VALUE
NBDY	meru	
NBDZ	meru	
NBDX	meru	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADSRAX	meru/g	
ADIAX	meru/g	
ADIAZ	meru/g	
ADIAY	meru/g	
X PIPA S. F. error	PPM	
Y PIPA S. F. error	PPM	
Z PIPA S. F. error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

DATA SHEET
(4-3)

PARAMETER	UNITS	RECORDED VALUE
NBDY	meru	
NBDZ	meru	
NBDX	meru	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADSRAX	meru/g	
ADIAZ	meru/g	
ADIAZ	meru/g	
ADIAZ	meru/g	
X PIPA S. F. error	PPM	
Y PIPA S. F. error	PPM	
Z PIPA S. F. error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

DATA SHEET

PARAMETER	UNITS	D ₁	MAX	D ₂	MAX	D ₃	MAX	
NBDY	meru		6.0		9.0		11.0	au
NBDZ	meru		6.0		9.0		11.0	av
NBDX	meru		6.0		9.0		11.0	aw
ADSRAY	meru/g		14.0		21.0		28.0	ax
ADSRAZ	meru/g		14.0		21.0		25.0	ay
ADSRAX	meru/g		14.0		21.0		25.0	az
AD ₁ AX	meru/g		17.0		33.0		40.0	ba
AD ₁ AZ	meru/g		17.0		33.0		40.0	bb
AD ₁ AY	meru/g		17.0		33.0		40.0	bc
X PIPA S. F.	Error PPM		400		500		600	bd
Y PIPA S. F.	Error PPM		400		500		600	be
Z PIPA S. F.	Error PPM		400		500		600	bf
X PIPA Bias	cm/sec ²		0.50		0.70		0.90	bg
Y PIPA Bias	cm/sec ²		0.50		0.70		0.90	bh
Z PIPA Bias	cm/sec ²		0.50		0.70		0.90	bi

6.3.10.2.2 Enter 0001 into R155. Verify and execute.

6.3.10.2.3 Enter 1111 into R154. Verify and execute.

6.3.10.2.4 Enter in C-156 $\pm XX.X001114$. (Enter a value for XX.X which will adjust the +14V power supply (GG 1020) as monitored on the CRT, to 12.1 (+0.1, -0.0) vdc. See Figure 2. Execute.

6.3.10.2.5 Enter in C-156 $\pm XX.X001124$ (Enter a value for XX.X which will adjust the +4V power supply (GG 1030) as monitored on the CRT, to 3.4 (+0.03, -0.00) vdc. See Figure 2. Execute.

6.3.10.2.6 On K-148 press ERROR RESET.

6.3.10.2.7 On K-148 initiate LGC Self-Check by entering the following:

VERB 21 NOUN 27 ENTR
77767 ENTR

Wait 200 seconds. Verify RESTART lamp on the DSKY is not lit.

6.3.10.2.7.1 Into R154 insert 0011. Verify and execute.

6.3.10.2.8 On the PSA Adapter Module place INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on the DSKY is lighted.

6.3.10.2.9 On the PSA Adapter Module place INHIBIT VOLTAGE FAIL switch to ON. Into R-154 insert 1111. Verify and execute. Press ERROR RESET. Perform the following DSKY operations.

VERB 21 NOUN 27 ENTR
77767 ENTR

6.3.10.2.10 Enter in C-156 (\pm) XX.X001114 (Enter a value for XX.X which will adjust the +14V power supply (GG 1020) as monitored on the CRT, to 16.4 (+0.1, -0.0) vdc. See Figure 2. Execute.

6.3.10.2.11 On K-148 press ERROR RESET. Wait 200 seconds. Verify RESTART lamp on DSKY is not lighted.

6.3.10.2.11.1 Into R154 insert 1100. Verify and execute.

6.3.10.2.12 On the PSA Adapter Module place INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on the DSKY is lighted. Set the INHIBIT VOLTAGE FAIL switch to ON. Into R-154 insert 1111. Verify and execute. Press ERROR RESET. Perform the following DSKY operations.

VERB 21 NOUN 27 ENTR
77767 ENTR

6.3.10.2.13 Enter in C-156 $\pm XX.X001124$ (Enter a value for XX.X which will adjust the 4V power supply (GG 1030) as monitored on the CRT, to 4.6 (+0.03, -0.0) vdc. See Figure 2. Execute.

6.3.10.2.14 On K-148 press ERROR RESET. Wait 200 seconds. Verify RESTART lamp on DSKY is not lit.

6.3.10.2.14.1 Into R154 insert 0011. Verify and execute.

6.3.10.2.15 On the PSA Adapter Module place INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on the DSKY is lit. Set the INHIBIT VOLTAGE FAIL switch to ON. Into R-154, insert 1111. Verify and execute. Press ERROR RESET. Perform the following DSKY operations:

VERB 21 NOUN 27 ENTR
77767 ENTR

6.3.10.2.16 Enter in C-156 $(\pm) XX.X001114$ (Enter a value for XX.X which will adjust the 14V power supply (GG 1020) as monitored on the CRT, to 12.1 (+0.1, -0) vdc. See Figure 2. Execute.

6.3.10.2.17 On K-148 press ERROR RESET. Wait 200 seconds. Verify RESTART lamp on DSKY is not lighted.

6.3.10.2.17.1 Into R154 insert 1100. Verify and execute.

6.3.10.2.18 On the PSA Adapter Module place INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on the DSKY is lighted.

6.3.10.2.19 On R-154 enter 0000. Execute.

6.3.10.2.20 On R-155 enter 0000. Execute.

6.3.10.2.21 On K-148 terminate the LGC Self-Check by entering the following:

VERB 21 NOUN 27 ENTR
00000 ENTR

6.3.10.2.22 On K-148 press ERROR RESET.

6.3.11 LGC Clock Frequency Test

6.3.11.1 Insure that LGC Operate power has been applied for a minimum of 10 minutes before performing this test.

6.3.11.2 Verify that the counter is connected to the 3.2kc signal on the hardline.

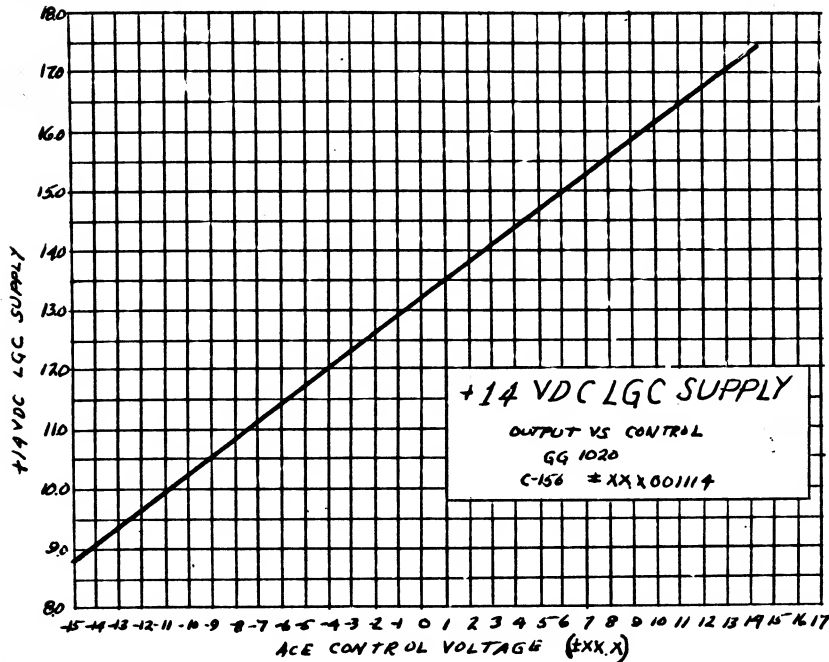
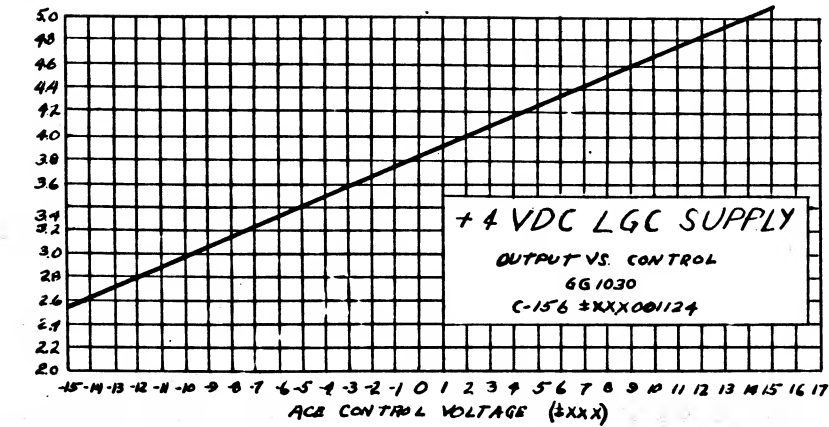


FIGURE 2

6.3.11.3 Insure that the counter has been warming up for a minimum of 30 minutes.

6.3.11.4 On the counter,

Set the FUNCTION switch to: MAN START

Set the TIME BASE switch to: 1 μ s TIME UNIT/COUNT

Set the SENSITIVITY control to: CHECK

6.3.11.5 Verify proper counter operation.

6.3.11.6 Set the FUNCTION switch to REMOTE OR TIME INTERVAL.

6.3.11.7 Plug in the Preset unit and set:

MODE switch to PRESET

N switches to 96000

6.3.11.8 Turn SAMPLE RATE control fully clockwise (HOLD). Wait 35 seconds for counter display to fill.

6.3.11.9 Start counting by depressing RESET switch on counter.

6.3.11.10 After approximately 30 seconds, read and record counter display.

6.3.11.11 Repeat steps 6.3.11.9 and 6.3.11.10.9 times.

6.3.11.12 The average of the 10 previous readings shall be 30.000000 \pm 0.000060 seconds.

6.3.11.13 Insure that the System is not in IMU Operate.

6.3.11.14 Enter the following on K-146 operations.

VERB 60 ENTR

00013 Press and hold the PRO pushbutton on the DSKY for 3

62000 seconds. Verify the STANDBY lamp is lighted.

6.3.11.15 Repeat steps 6.3.11.9 through 6.3.11.12.

Press and hold the PRO pushbutton on the DSKY for 3 seconds. Verify the Standby lamp is lighted.

6.3.11.16 Press and hold the PRO pushbutton on the DSKY for 3 seconds. Verify the STANDBY lamp is not lighted. If the STANDBY light remains lit, depress the PRO pushbutton for a maximum of two additional times. RESTART lamp may come on. Enter VERB 61 ENTR on K-148.

6.3.11.17 On the Computer Control and Reticule dimmer assembly, press and hold MARK X pushbutton.

6.3.11.18 On the DSKY observe

VERB 05 NOUN 31
Row 1 = 00112
Prog Alarm lamp is lighted
Press Error Reset

6.3.11.19 Enter the following on K-148

VERB 11 NOUN 10 ENTR
00016 ENTR

6.3.11.20 Observe that DSKY Row 1 displays 00004.

6.3.11.21 Release MARK X pushbutton

6.3.11.22 Observe that DSKY Row 1 displays 00000.

6.3.11.23 Press and hold the MARK Y pushbutton on the Computer Control and Reticule Dimmer Assembly.

6.3.11.23.1 On the DSKY Observe

VERB 05 NOUN 31
Row 1 = 00112
Program Alarm lamp is lighted
Press ERR Reset

6.3.11.23.2 Enter the following on K-148:

VERB 11 NOUN 10 ENTR
00016 ENTR

6.3.11.24 Observe that DSKY Row 1 displays 00010.

6.3.11.25 Release MARK Y pushbutton

6.3.11.26 Observe that DSKY Row 1 displays 00000.

6.3.11.27 Press and hold the REJECT pushbutton on the Computer Control and Reticle Dimmer Assembly.

6.3.11.27.1 On the DSKY observe

VERB 05 NOUN 31
Row 1 = 00112
Prog alarm lamp is lighted
Press ERR Reset

6.3.11.27.2 Enter the following on K-148:

VERB 11 NOUN 10 ENTR
00016 ENTR

6.3.11.28 Observe that DSKY Row 1 displays 00020.

6.3.11.29 Release the REJECT pushbutton.

6.3.11.30 Observe that DSKY Row 1 displays 00000.

6.3.11.31 On the DSKY perform the following operation

VERB 36 ENTR

6.3.11.32 On panel 11 close PGNS AOT lamp circuit breaker. On the Computer Control and Reticle dimmer assembly, rotate the RETICLE BRIGHTNESS control to its minimum light intensity position. View through the AOT and verify that the reticle lamp is off.

6.3.11.33 While viewing through the AOT, slowly rotate the RETICLE BRIGHTNESS control to increase the reticle brightness until a stop is reached. Observe that the reticle brightness has increased in intensity. Return RETICLE BRIGHTNESS control to off state. On panel 11 open PGNS AOT lamp circuit breaker.

6.3.11.34 AOT eyepiece Heater Test.

6.3.11.34.1 Secure milliammeter HP 428B and current probe HP428A-21A.

6.3.11.34.2 Locate P1 at Computer Control and Reticle Dimmer assembly. Push lacing cord away from P1 back to fifth tie point.

6.3.11.34.3 Clip current probe HP428A-21A to blue wire in cable with red arrow pointing away from P1. Measure and record current indication. The current shall be between 139 and 244 ma.

6.3.11.34.4 Remove current probe, push lacing cord back to P1 and spot tie.

6.3.12 Gimbal Friction Test

6.3.12.1 Inner Gimbal Friction Test

6.3.12.1.1 On K-148 enter the following sequence:

VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+17000 ENTR
+17000 ENTR
+17000 ENTR
Wait 15 seconds

VERB 41 NOUN 20 ENTR
+27000 ENTR
+27000 ENTR
+27000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR

6.3.12.1.2 On the CRT, verify CDU X, CDU Y, CDU Z indicate +00000 (± 00200).

6.3.12.1.3 Set up Analog Recorder to monitor the following signals:

MEAS. NO.	SIGNAL NAME
a. GG2110	IG Torque Motor Current
b. GG2106	IG Servo Error Total
c. GG2107	IG Servo Error in Phase
d. GG2112	IG 1x Resolver Sine
e. GG2113	IG 1x Resolver Cosine
f. GG2220	IG CDU Fine Error
g. GG1201	IMU 28V 1% 800 CPS
h. GG2221	IG CDU Coarse Error

6.3.12.1.4 Set up Analog Recorder to monitor the following signals:

MEAS NO.	SIGNAL NAME
a. GG2300	PIPA TEMP
b. GG2301	IRIG TEMP
c. GG1520	+28 VDC LGC OPR BUS

6.3.12.1.5 After 10 seconds has elapsed since step 6.3.12.1.1, enter the following into K-148.

VERB 21 NOUN 01 ENTR
00403 ENTR
00000 ENTR

6.3.12.1.6 Verify on CRT, DSKY display

VERB 21 NOUN 01
R1 = 00000
R3 = 00403

6.3.12.1.7 On K-148 enter the following sequence:

NOUN 15 ENTR
00000 ENTR ENTR
37777 ENTR ENTR
37743 ENTR ENTR
00000 ENTR ENTR
00000 ENTR (once)

6.3.12.1.8 IG - 360° TORQUE

6.3.12.1.9 On K-148 enter the following sequence:

VERB 01 NOUN 01 ENTR
00370 ENTR
Record contents of CRT DSKY Row 1 xxxY
VERB 21 NOUN 01 ENTR
00370 ENTR
XXXXY' ENTR
Where Y' is obtained from Table 1
VERB 42 ENTR
VERB 33 ENTR

6.3.12.1.10 Monitor analog recorder. When the IG Torque Motor Current signal (GG2110) drops to a quiescent level (approximately 12 minutes), stop the recorders.

6.3.12.1.11 On K-148 enter the following sequence:

VERB 40 NOUN 20 ENTR
Wait 3 seconds
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+17000 ENTR
+17000 ENTR
+17000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+27000 ENTR
+27000 ENTR
+27000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR

6.3.12.1.12 On the CRT, verify CDU X, CDU Y, CDU Z all indicate +00000 (±00200).

6.3.12.1.13 After 10 seconds has elapsed since step 6.3.12.1.11 enter the following sequence into K-148:

VERB21 NOUN 01 ENTR
00403 ENTR
00000 ENTR

6.3.12.1.14 Verify on CRT, DSKY display

VERB 21	NOUN 01
R1	00000
R3	00403

6.3.12.1.15 On K-148 enter the following sequence:

NOUN 15	ENTR	
00000	ENTR	ENTR
40000	ENTR	ENTR
40034	ENTR	ENTR
00000	ENTR	ENTR
00000	ENTR	(once)

6.3.12.1.16 IG + 360° TORQUE

6.3.12.1.17 On K-148 enter the following sequence

VERB 42	ENTR
VERB 33	ENTR

6.3.12.1.18 Monitor analog recorder. When the IG Torque Motor Current signal (GG2110) drops to a quiescent level (approximately 12 minutes), stop the recorders.

6.3.12.2 Outer Gimbal Friction Test

6.3.12.2.1 On K-148 enter the following sequence:

VERB 40 NOUN 20 ENTR
Wait 3 seconds
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+17000 ENTR
+17000 ENTR
+17000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+27000 ENTR
+27000 ENTR
+27000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR

APOLLO G&N Specification
ND1002323 REV M

6.3.12.2.2 On the CRT, verify CDU X, CDU Y, CDU Z indicate +00000 (± 00200).

6.3.12.2.3 Set up analog recorder to monitor the following:

MEAS NO.	SIGNAL NAME
a. GG2167	OG Servo Error In Phase
b. GG2170	OG Torque Motor Current
c. GG2166	OG Servo Error Total
d. GG2280	OG CDU Fine Error
e. GG2172	OG 1x Resolver Sine
f. GG2173	OG 1x Resolver Cosine
g. GG2281	OG CDU Coarse Error

6.3.12.2.4 After 10 seconds has elapsed since step 6.3.12.2.1 enter the following sequence into K-148:

VERB 21	NOUN 01	ENTR
00403	ENTR	
37777	ENTR	

6.3.12.2.5 Verify on CRT, DSKY display

VERB 21	NOUN 01
R1	37777
R3	00403

6.3.12.2.6 On K-148 enter the following sequence:

NOUN 15	ENTR	
37743	ENTR	ENTR
00000	ENTR	ENTR
00000	ENTR	ENTR
00000	ENTR	ENTR
00000	ENTR	(once)

6.3.12.2.7 OG - 360° TORQUE

6.3.12.2.8 On K-148 enter the following sequence:

VERB 42	ENTR
VERB 33	ENTR

6.3.12.2.9 Monitor analog recorder. When the OG Torque Motor Current signal (GG2170) drops to a quiescent level (approximately 12 minutes) stop the recorders.

6.3.12.2.10 On K-148 enter the following sequence:

VERB 40 NOUN 20	ENTR
Wait 3 seconds	
VERB 41 NOUN 20	ENTR
+00000	ENTR
+00000	ENTR
+00000	ENTR
Wait 15 seconds	
VERB 41 NOUN 20	ENTR
+17000	ENTR
+17000	ENTR
+17000	ENTR
Wait 15 seconds	
VERB 41 NOUN 20	ENTR
+27000	ENTR
+27000	ENTR
+27000	ENTR
Wait 15 seconds	
VERB 41 NOUN 20	ENTR
+00000	ENTR
+00000	ENTR
+00000	ENTR

6.3.12.2.11 On the CKT, verify CDU X, CDU Y, CDU Z indicate +00000 (± 00200).

6.3.12.2.12 After 10 seconds has elapsed since step 6.3.12.2.10, enter the following sequence into K-148.

VERB 21 NOUN 01	ENTR
00403	ENTR
40000	ENTR

6.3.12.2.13 Verify on CRT, DSKY display.

VERB 21 NOUN 01	
R1	40000
R3	00403

6.3.12.2.14 On K-148 enter the following sequence:

NOUN 15 ENTR
40034 ENTR ENTR
00000 ENTR ENTR
00000 ENTR ENTR
00000 ENTR ENTR
00000 ENTR ENTR

6.3.12.2.15 OG +360° TORQUE

6.3.12.2.16 On K-148 enter the following sequence

VERB 42 ENTR
VERB 33 ENTR

6.3.12.2.17 Monitor analog recorder. When the OG Torque Motor Current signal (GG2170) drops to a quiescent level (approximately 12 minutes) stop the recorders.

6.3.12.3 Middle Gimbal Friction Test

6.3.12.3.1 On K-148 enter the following sequence:

VERB 40 NOUN 20 ENTR
Wait 3 seconds
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+17000 ENTR
+17000 ENTR
+17000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+27000 ENTR
+27000 ENTR
+27000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+06750 ENTR

6.3.12.3.2 On the CRT, verify CDU X = $+00000 \pm 00200$, CDU Y = $+00000 \pm 00200$, and CDU Z = $+06750 \pm 00200$.

6.3.12.3.3 Set up analog recorder to monitor the following:

MEAS. NO.	SIGNAL NAME
a. GG2136	MG Servo Error Total
b. GG2137	MG Servo Error In Phase
c. GG2140	MG Torque Motor Current
d. GG2143	MG 1x Resolver Cosine
e. GG2250	MG CDU Fine Error
f. GG2142	MG 1x Resolver Sine
g. GG2251	MG CDU Coarse Error

6.3.12.3.4 After 10 seconds have elapsed since step 6.3.12.3.1, enter the following sequence into K-148:

```
VERB 21 NOUN 01 ENTR
00403      ENTR
00000      ENTR
```

6.3.12.3.5 Verify on CRT, DSKY display

```
VERB 21 NOUN 01
R1 =      0000
R3 =      00403
```

6.3.12.3.6 On K-148 enter the following sequence:

```
NOUN 15      ENTR
00000      ENTR ENTR
00000      ENTR ENTR
00000      ENTR ENTR
14000      ENTR ENTR
00000      ENTR (once)
```

6.3.12.3.7 MG - 135° TORQUE

6.3.12.3.8 On K-148 enter the following sequence:

```
VERB 42      ENTR
VERB 33      ENTR
```

6.3.12.3.9 Monitor analog recorder. When MG Torque Motor Current (GG2140) drops to a quiescent level (approximately 6 minutes), stop the recorders.

6.3.12.3.10 On K-148 enter the following sequence:

VERB 40 NOUN 20 ENTR
Wait 3 seconds
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+17000 ENTR
+17000 ENTR
+17000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+27000 ENTR
+27000 ENTR
+27000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
-06750 ENTR

6.3.12.3.11 On the CRT, verify CDU X = +00000±00200, CDU Y = +00000±00200, and
CDU Z = -06750±00200.

6.3.12.3.12 After 10 seconds has elapsed since step 6.3.12.3.10, enter the following sequence into K-148.

```
VERB 21  NOUN 01  ENTR
00403    ENTR
00000    ENTR
```

6.3.12.3.13 On the CRT, DSKY display verify:

```
VERB 21  NOUN 01
R1 =      00000
R3 =      00403
```

6.3.12.3.14 On K-148 enter the following sequence:

```
NOUN 15  ENTR
00000    ENTR      ENTR
00000    ENTR      ENTR
00000    ENTR      ENTR
63777    ENTR      ENTR
77777    ENTR      (once)
```

6.3.12.3.15 MG +135° TORQUE is using a chart speed of 10 mm/sec. (MG +135° TORQUE)

6.3.12.3.16 On K-148 enter the following sequence:

```
VERB 42  ENTR
VERB 33  ENTR
```

6.3.12.3.17 Monitor analog recorder. When the MG Torque Motor Current signal (GG2140) drops to a quiescent level (approximately 6 minutes) stop the recorders.

6.3.12.3.18 On K-148 enter the following sequence:

```
VERB 41  NOUN 20  ENTR
+00000    ENTR
+00000    ENTR
+00000    ENTR
```

6.3.12.4 Test Analysis

6.3.12.4.1 Remove the strip charts from analog recorders

6.3.12.4.2 Examine the traces of the recorded measurements for all six phases of this test to detect any sharp discontinuities. Disregard transients of 0.5 second duration or less on the Gimbal Torque Motor current traces and disregard all transients on the CDU Fine Error and CDU Coarse Error traces. The Gimbal Torque Motor currents shall not exceed 0.125 ampere. The CDU Fine Error measurements shall not exceed ± 70 mv rms. The CDU Coarse Error measurement shall not exceed ± 680 mv rms.

6.3.13 Stabilization Loop Step Response Test

6.3.13.1 IG Response Test

6.3.13.1.1 On K-148 enter the following sequence:

```
VERB 40  NOUN 20  ENTR  Wait 3 seconds
VERB 41  NOUN 20  ENTR
+00000  ENTR
+00000  ENTR
+00000  ENTR
```

6.3.13.1.2 On CRT, verify IG MG, and OG gimbal angles are between 358 and 002.

6.3.13.1.3 Set up analog recorder to monitor the following:

MEAS NO.	SIGNAL NAME
a. GG2110	IG Torque Motor Current
b. GG2106	IG Servo Error Total
c. GG2107	IG Servo Error In Phase
d. GG2112	IG 1X Resolver Sine
e. GG2113	IG 1X Resolver Cosine
f. GG2220	IG CDU Fine Error
g. GG1201	IMU 28V 1 PCT 800 CPS

6.3.13.1.4 On K-148 initiate FINE ALIGN by entering the following sequence:

```
VERB 42  ENTR
+00000  ENTR
+00000  ENTR
+00000  ENTR
```


6.3.13.1.5 On the CRT verify CDU X, CDU Y and CDU Z indicate +00000±00200.

CAUTION: If the transients caused by the subsequent step input do not damp out within 15 seconds, remove IMU Operate Power.

6.3.13.1.6 Enter 1000 into R-START 155.

6.3.13.1.7 Press XEQ/SEAL pushbutton on R-155 to enter the DC step voltage into the IG stabilization loop.

6.3.13.1.8 Prepare to start analog recorder at a chart speed of 100 mm/sec. (IG RESPONSE TEST)

6.3.13.1.9 Enter 0000 into R-START 155. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the IG stabilization loop.

6.3.13.1.10 After the transient on the recorder has died out, stop the recorder.

6.3.13.1.11 From the Servo Error In Phase signal recorder trace measure the time interval (T1, Fig. 3) between the removal of the step input to the point at which the trace settles to within 5 percent of the step magnitude (A, Fig. 3). The period T1, shall not exceed 0.1 second and the trace shall have no more than 3 overshoots.

6.3.13.2 MG Response Test

6.3.13.2.1 Set up analog recorder to monitor the following:

MEAS. NO.	SIGNAL NAME
a. GG2136	MG Servo Error Total
b. GG2137	MG Servo Error in Phase
c. GG2140	MG Torque Motor Current
d. GG2143	MG 1X Resolver Cosine
e. GG2250	MG CDU Fine Error
f. GG2142	MG 1X Resolver Sine
g. GG1201	IMU 28V 1 800 cps

6.3.13.2.2 On the CRT, verify CDU X, CDU Y and CDU Z indicate +00000 (±00200).

CAUTION: If the transients caused by the subsequent step input do not die out within 15 seconds, remove IMU Operate power.

6.3.13.2.3 Enter 0100 into R-START 155. Press XEQ/SEAL pushbutton on R-155 to enter the DC step voltage into the MG stabilization loop.

6.3.13.2.4 Prepare to start analog recorder at a chart speed of 100 mm/sec. (MG RESPONSE TEST).

6.3.13.2.5 Enter 0000 into R-START 155. Start analog recorder. Press XEQ/SEAL pushbutton to remove the step input to the MG stabilization loop.

6.3.13.2.6 After the transient on the recorder has died out, stop the recorder.

6.3.13.2.7 From the Servo Error In Phase signal recorder trace measure the time interval (T1 Fig. 3) between the removal of the step input to the point at which the trace settles to within 5 percent of the step magnitude (A, Fig 3). The period, T1, shall not exceed 0.1 seconds and the trace shall have no more than 3 overshoots.

6.3.13.3 OG Response Test

6.3.13.3.1 Set up analog recorder to monitor the following:

MEAS. NO.	SIGNAL NAME
a. GG2167	OG Servo Error In Phase
b. GG2170	OG Torque Motor Current
c. GG2166	OG Servo Error Total
d. GG2280	OG CDU Fine Error
e. GG2173	OG 1X Resolver Sine
f. GG2173	OG 1X Resolver Cosine
g. GG1201	IMU 28V 1% 800 cps

6.3.13.3.2 On the CRT, verify CDU X, CDU Y and CDU Z indicate +00000 (± 0.0200).

CAUTION: If the transients caused by the subsequent step input do not die out within 15 seconds, remove IMU operate power.

6.3.13.3.3 Enter 0010 into R-START 155. Press XEQ/SEAL pushbutton on R-155 to enter the DC step voltage into the OG stabilization loop.

6.3.13.3.4 Prepare to start analog recorder at a chart speed of 100 mm/sec. (OG RESPONSE TEST).

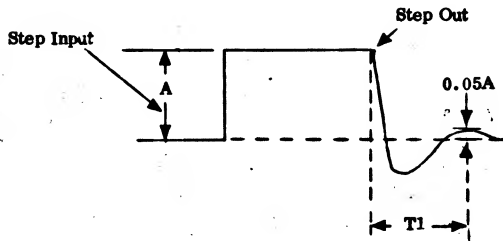
6.3.13.3.5 Enter 0000 into R-155. Start analog recorder. Press XEQ/SEAL pushbutton to remove the step input to the OG stabilization loop.

6.3.13.3.6 After the transient on the recorder has died out, stop the recorder.

6.3.13.3.7 From the Servo Error In Phase signal recorder trace, measure the time interval (T_1 , Fig 3) between the removal of the step input to the point at which the trace settles to within 5 percent of the step magnitude (A , Fig 3). The period, T_1 , shall not exceed 0.1 second and the trace shall have no more than 5 overshoots.

6.3.13.3.8 On K-148 enter the following sequence:

VERB 41	NOUN 20	ENTR
+00000	ENTR	
+00000	ENTR	
+00000	ENTR	



TYPICAL STAB LOOP RESPONSE TO STEP INPUT

FIGURE 3

6.3.14 G&N Fine Alignment Test

6.3.14.1 On K-148 enter:

VERB 01 NOUN 10 ENTR
00003 ENTR

6.3.14.2 Record CRT, DSKY Row 1 display as AAAAA and the time of day.

6.3.14.3 On K-148 enter:

VERB 21 NOUN 01 ENTR
01300 ENTR
AAAAA ENTR
VERB 06 NOUN 02 ENTR
01300 ENTR

6.3.14.4 Record CRT DSKY Row 1 display as ±BBBBB

6.3.14.5 Perform the following calculations:

a. $\frac{\text{BBBBBX } 5.12}{3600} = \text{CCCC.C}$ Contents of high order scalar register in hours.

6.3.14.5.b Calculate the times of day at which the contents of the high order scalar will be at the following times.

2.91
5.82
8.73
11.64
14.55
17.46
20.37
23.30

6.3.14.6 If the time of day is within 12 minutes of any of those times calculated in 6.3.14.5.b when about to complete step 6.3.14.30 wait until that time has passed and then proceed.

6.3.14.7 On K-148 enter:

VERB 01 NOUN 01 ENTR
00370 ENTR
Record contents of DSKY Row 1 xxxxy
VERB 21 NOUN 01 ENTR
000370 ENTR
XXXXY' ENTR
Where Y' is obtained from Table 1a.
VERB 57 ENTR
00003 ENTR

6.3.14.8 Verify CRT DSKY display is:

VERB 06 NOUN 61 flashing
R1 = +13500 (SM Azimuth)
R2 = +40748 (Site Latitude)

NOTE: If R1 and R2 indications are correct proceed to step 6.3.14.10.

6.3.14.9 On K-148 enter:

VERB 21 ENTR
+13500 ENTR
VERB 22 ENTR
+40748 ENTR

6.3.14.10 On K-148 enter:

VERB 33 ENTR
Observe on CRT DSKY display
VERB 21 NOUN 30 (Flashing)

6.3.14.11 On K-148 enter:

0000X ENTR (Test position, either 1 or 2)
00000 ENTR (Use AOT)

Observe on CRT DSKY display:

VERB 06 NOUN 61 (Flashing)

Disregard Row 1, 2, and 3 indications.

6.3.14.12 On K-148 enter:

VERB 21 ENTR
+XXX.XX ENTR (L tgt. true azimuth)
VERB 22 ENTR
+XX.XXX ENTR (L tgt. elevation)
VERB 23 ENTR
00001 ENTR (L tgt. number)
VERB 33 ENTR

Observe on CRT DSKY display:

VERB 06 NOUN 61 (Flashing)

Disregard Row 1, 2 and 3 indications.

6.3.14.13 On K-148 enter:

VERB 21 ENTR
+XXX.XX ENTR (F tgt. true azimuth)
VERB 22 ENTR
+XX.XXX ENTR (F tgt. elevation)
VERB 23 ENTR
00002 ENTR (F tgt. number)
VERB 33 ENTR

Observe on CRT DSKY display:

VERB 51 (flashing)

R1 = 00001

6.3.14.14 On Computer Control and Reticle Dimmer Assembly, press MARK X pushbutton.

Observe on DSKY display:

VERB 21 NOUN 30 (Flashing)

6.3.14.15 On DSKY press ENTR

Observe on DSKY display:

VERB 21 NOUN 43 (Flashing)

6.3.14.16 On DSKY enter:

00001 ENTR (L Detent Code)

Observe on DSKY display

VERB 21 NOUN 42 (Flashing)

6.3.14.17 Set AOT to "L" position

6.3.14.18 Rotate AOT control knob until the center of the L tgt reticle is super imposed between the double Y reticle. Record AOT counter value as LY XXX.XX.

6.3.14.19 Rotate AOT control knob until the center of the L tgt reticle is superimposed between the double lines of the SPIRAL reticle. Record AOT counter value as LS XXX.XX.

6.3.14.20 On DSKY enter:

±XXX.XX ENTR (value of LY)

Observe on DSKY display:

VERB 22 NOUN 42 (Flashing)

6.3.14.21 On DSKY enter:

±XXX.XX ENTR (Value of LS)

Observe on DSKY display:

VERB 51 (Flashing)

R1 = 00002

6.3.14.22 On Computer Control and Reticle Dimmer Assembly, press MARK X pushbutton. Observe on DSKY display:

VERB 21 NOUN 30 (Flashing)

6.3.14.23 On DSKY press ENTR. Observe on DSKY display:

VERB 21 NOUN 43 (Flashing)

6.3.14.24 On DSKY enter:

00002 ENTR (F Detent Code)

Observe on DSKY display:

VERB 21 NOUN 42 (Flashing)

6.3.14.25 Set AOT to "F" position

6.3.14.26 Rotate AOT control knob until the center of the F tgt. reticle is superimposed between the double Y reticle. Record AOT counter value as FY XXX.XX.

6.3.14.27 Rotate AOT control knob until the center of the F tgt. reticle is superimposed between the double lines of the SPIRAL reticle. Record AOT counter value as FS XXX.XX.

6.3.14.28 On DSKY enter:

±XXX.XX ENTR (value of FY)

Observe on DSKY display:

VERB 22 NOUN 42 (Flashing)

6.3.14.29 On DSKY enter:

±XXX.XX ENTR (value of FS)

NOTE: Wait until DSKY display indicates VERB 51 (Flashing) R1 = 00001 before proceeding.

NOTE: Before completing step 6.3.14.30 check time of day to verify that the high order scalar will not overflow within the next 12 minutes.

6.3.14.30 Repeat steps 6.3.14.14 through 6.3.14.29.

6.3.14.31 In approximately 7 minutes, observe on CRT DSKY display and record.

VERB 06 NOUN 66 (Flashing)

R1 = XXXXX (Whole number part of Y_{sm} misalignment about Z_{sm})

R2 = .XXXXX (Fractional number part of Y_{sm} misalignment about Z_{sm} .)

6.3.14.32 On K-148 enter.

VERB 33 ENTR

Observe on CRT DSKY display and record:

VERB 06 NOUN 66 (Flashing)

R1 = XXXXX (Whole number part of Z_{sm} misalignment about Y_{sm})

R2 = .XXXXX (Fractional number part of Z_{sm} misalignment about Y_{sm})

6.3.14.33 On K-148 enter:

VERB 36 ENTR

Press ERROR RESET

6.3.14.34 Repeat steps 6.3.14.7 through 6.3.14.30.

6.3.14.35 In approximately 7 minutes, observe on CRT DSKY display and record:

VERB 06 NOUN 66 (Flashing)

R1 = XXXXX (Whole number part of X_{sm} misalignment about Y_{sm})

R2 = .XXXXX (Fractional number part of X_{sm} misalignment about Y_{sm})

6.3.14.36 On K-148 enter:

VERB 33 ENTR

Observe on CRT DSKY display and record:

VERB 06 NOUN 66 (Flashing)

R1 = XXXXX (Whole number part of Y_{sm} misalignment about X_{sm})

R2 = .XXXXX (Fractional number part of Y_{sm} misalignment about X_{sm})

6.3.14.37 On K-148 enter:

VERB 36 ENTR

Press ERROR RESET

VERB 41 NOUN 20 ENTR

+00000 ENTR

+00000 ENTR

+00000 ENTR

6.3.14.38 Results. The PIPA bias determined previously in the IMU Performance Test (6.3.9) must be subtracted from the resultant data of the test. The PIPA bias terms from paragraph 6.3.9 must be multiplied by a factor of 210 before performing the calculations in paragraphs 6.3.14.38.1 thru 6.3.14.38.4.

6.3.14.38.1 Y PIPA misalignment

	R1	R2
About Z axis (from 6.3.14.31) =	$\pm \text{XXXXXX}$	$\text{XXXXXX} \text{ sec}$
Less Y PIPA bias (from 6.3.9) =	$-(\pm \text{XXXXXX})$	$\text{XXXXXX} \text{ sec}$
Y PIPA misalignment about Z axis =	-----	$\text{-----} \text{ sec}$

This value shall not exceed $\pm 600 \text{ sec}$

6.3.14.38.2 Z PIPA misalignment

	R1	R2
About Y axis (from 6.3.14.32) =	$\pm \text{XXXXXX}$	$\text{XXXXXX} \text{ sec}$
Less Z PIPA bias (from 6.3.9) =	$-(\pm \text{XXXXXX})$	$\text{XXXXXX} \text{ sec}$
Z PIPA misalignment about Y axis =	$\pm \text{-----}$	$\text{-----} \text{ sec}$

This value shall not exceed $\pm 600 \text{ sec}$

6.3.14.38.3 X PIPA misalignment

	R1	R2
About Y axis (from 6.3.14.35) =	$\pm \text{XXXXXX}$	$\text{XXXXXX} \text{ sec}$
Less X PIPA bias from (6.3.9) =	$-(\pm \text{XXXXXX})$	$\text{XXXXXX} \text{ sec}$
X PIPA misalignment about Y axis =	$\pm \text{-----}$	$\text{-----} \text{ sec}$

This value shall not exceed $\pm 600 \text{ sec}$

6.3.14.38.4 Y PIPA misalignment

	R1	R2
About X axis from (6.3.14.36) =	$\pm \text{XXXXXX}$	$\text{XXXXXX} \text{ sec}$
Less Y PIPA bias (from 6.3.9) =	$-(\pm \text{XXXXXX})$	$\text{XXXXXX} \text{ sec}$
Y PIPA misalignment about X axis =	$\pm \text{-----}$	$\text{-----} \text{ sec}$

This value shall not exceed $\pm 600 \text{ sec}$

6.3.15 AOT Functional Accuracy Test.

NOTE: Use of a Dioptrimeter is required when sighting through AOT. The included angles between target LOS shall be known to ± 10 arc seconds. The elevation of each target LOS shall be known to ± 15 arc seconds.

6.3.15.1 Use of Dioptrimeter is required when sighting through AOT.

6.3.15.1 Insure that G&N System is in the Operate Mode.

6.3.15.2 On K-148 enter:

VERB 21 NOUN 03	ENTR
01462	ENTR
XXX,XX	ENTR (Detent L az data)
	ENTR
01463	ENTR
XXX,XX	ENTR (Detent F az data)
	ENTR
01464	ENTR
XXX,XX	ENTR (Detent R az data)
	ENTR
01465	ENTR
XXX,XX	ENTR (Detent L EL data)
	ENTR
01466	ENTR
XXX,XX	ENTR (Detent F EL data)
	ENTR
01467	ENTR
XXX,XX	ENTR (Detent R EL data)

6.3.15.3 While viewing through the AOT, instruct a target operator to translate (vertically and laterally) and rotate (in azimuth and elevation) a target until the center of the reticle is visible in the Left and Forward detent AOT positions. To be referred to as target L.

6.3.15.4 Level the Theodolite base while insuring that the center of the target reticle remains in the two fields of view.

6.3.15.5 When it has been assured that the Theodolite is level, zero the theodolite azimuth dial.

6.3.15.6 While viewing through the AOT, instruct a target operator to translate (vertically and laterally) and rotate (in azimuth and elevation) a target until the target reticle is visible in the Right and Forward detent AOT positions. To be referred to as target R.

6.3.15.7 Level the Theodolite base while assuring that the target reticle remains visible in the two AOT fields of view.

6.3.15.8 When it has been assured that the Theodolite is level and the target reticle is visible, zero the Theodolite azimuth dial.

6.3.15.9 Verify that the Theodolite bases are level. Place the AOT in each detent position from left to right and verify that each target reticle is still visible and in the proper fields of view. If adjustments are required insure that the azimuth dial is rezeroed. Repeat this target scanning process until the AOT operator is satisfied with target placement.

6.3.15.10 AOT measurement of X_1 .

6.3.15.10.1 On K-158 enter:

VERB 57	ENTR
00012	ENTR

Observe VERB 51 flashing and R1 = 00001 on CRT DSKY display.

6.3.15.10.2 On Computer Control and Reticle Dimming Assembly, press MARK X pushbutton.

6.3.15.10.3 Observe VERB 21 NOUN 30 flashing on DSKY.

6.3.15.10.4 On the DSKY enter:

00000	ENTR
-------	------

Observe VERB 21 NOUN 43 flashing.

00001	ENTR
-------	------

Observe VERB 21 NOUN 42 flashing

6.3.15.10.5 Set AOT in L detent position.

6.3.15.10.6 Rotate the AOT control knob clockwise until the center of the L target reticle is superimposed between the double Y reticle. Read and record LY = XXX.XX.

6.3.15.10.7 Rotate the AOT control knob until the center of the L target reticle is superimposed between the double SPIRAL lines of AOT reticle. Record AOT dial indication as LS = XXX.XX.

6.3.15.10.8 On DSKY enter:

±XXX.XX	ENTR (L Y from 6.3.15.10.6)
---------	-----------------------------

Observe VERB 22 NOUN 42 flashing.

±XXX.XX	ENTR (L S from 6.3.15.10.7)
---------	-----------------------------

Observe VERB 51 flashing and R1 = 00002.

6.3.15.10.9 On the Computer Control and Reticle Dimming Assembly press MARK X pushbutton.

6.3.15.10.10 Observe VERB 21 NOUN 30 flashing on DSKY.

6.3.15.10.11 On DSKY enter:

00000	ENTR
-------	------

Observe VERB 21 NOUN 43 flashing.

00002	ENTR
-------	------

Observe VERB 21 NOUN 42 flashing.

6.3.15.10.12 Set AOT in F detent position.

6.3.15.10.13 Rotate the AOT control knob clockwise until the center of the L target reticle is superimposed between the double Y reticle. Record AOT dial indication as FLY = XXX,XX.

6.3.15.10.14 Rotate the AOT control knob until the center of the L target reticle is superimposed between the double SPIRAL reticle lines. Record the AOT dial indication as FLS = XXX,XX.

6.3.15.10.15 On the DSKY enter:

±XXX,XX ENTR (FLY from 6.3.15.10.13)

Observe VERB 22 NOUN 42 flashing

±XXX,XX ENTR (FLS from 6.3.15.10.14)

Observe VERB 06 NOUN 03 displayed. Record R1, the angle should be zero (0) ± 0.08 degree.

6.3.15.11 AOT measurement of X_2 .

6.3.15.11.1 On K-148 enter:

VERB 57 ENTR
00012 ENTR

Observe VERB 51 flashing and R1 = 00001.

6.3.15.11.2 On the Computer Control and Reticle Dimming Assembly, press MARK X push-button.

6.3.15.11.3 Observe VERB 21 NOUN 30 flashing on DSKY.

6.3.15.11.4 On the DSKY enter:

00000 ENTR

Observe VERB 21 NOUN 43 flashing

00002 ENTR

Observe VERB 21 NOUN 42 flashing

6.3.15.11.5 Verify AOT is in the F detent position.

6.3.15.11.6 Rotate the AOT control knob clockwise until the center of the R target reticle is superimposed between the double Y reticle. Record the AOT dial indication as FRY = XXX,XX.

6.3.15.11.7 Rotate the AOT control knob until the center of the R target reticle is superimposed between the double SPIRAL reticle lines. Record the AOT dial indication as FRS = XXX.XX.

6.3.15.11.8 On the DSKY enter:

±XXX.XX ENTR (FRY from 6.3.15.11.6)

Observe VERB 22 NOUN 42 flashing.

±XXX.XX ENTR (FRS from 6.3.15.11.7)

Observe VERB 51 flashing and R1 = 00002.

6.3.15.11.9 On the Computer Control and Reticle Dimming Assembly, press MARK X push-button.

6.3.15.11.10 Observe VERB 21 NOUN 30 flashing on DSKY.

6.3.15.11.11 On the DSKY enter:

00000 ENTR

Observe VERB 21, NOUN 43 flashing

00003 ENTR

Observe VERB 21 NOUN 42 flashing

6.3.15.11.12 Set the AOT in the R detent position.

6.3.15.11.13 Rotate the AOT control knob clockwise until the center of the R target reticle is superimposed between the double Y reticle. Record the AOT dial indication as RY = XXX.XX.

6.3.15.11.14 Rotate the AOT control knob until the center of the R target reticle is superimposed between the double SPIRAL reticle lines. Record the AOT dial indication as RS = XXX.XX.

6.3.15.11.15 On the DSKY enter:

±XXX.XX ENTR (R Y from 6.3.15.11.13)

Observe VERB 22 NOUN 42 flashing

±XXX.XX ENTR (R S from 6.3.15.11.14)

Observe VERB 06 NOUN 03 displayed. Record R1, the angle should be zero (0) ± 0.08 degree.

APPENDIX I

MEASUREMENT TOLERANCES

<u>SIGNAL</u>	<u>SIGNAL NAME</u>	<u>G&N LAB TEST REQUIREMENT</u>	<u>PSAAM AND/OR SCA UNCERTAINTY 1% OF FULL SCALE</u>
GG 1080 link 4*	+14 vdc LGC Supply	14.0±0.4 vdc	0%
GG 1030 link 4	+4 vdc LGC Supply	4.0±0.2 vdc	0%
GG 1040 link 5**	+120 vdc PIPA Supply	120±6.0 vdc	1%
GG 1070 link 4	+4 vdc CDU Supply	4.0±0.2 vdc	0%
GG 1100 link 4	-28 vdc Supply	-27.5±6.0 vdc	0%
GG 1110 link 5	2.5 vdc Telemetry Bias No. 1	2.5±0.06 vdc	0%
GG 1201 link 5	IMU 28V 800 cps 1%	28±0.56V rms	1%
GG 1202 link 4	IMU 28V 800 cps 5%	28±1.4V rms	1.5%
GG 1203 link 4	IMU 28V 800 cps 5%	28±2.1V rms	1.5%
GG 1331 link 5	3.2 kc 28V Supply 1%	28.6±0.56V rms	1%
GG 1500 link 4	+28 vdc IMU Oper BUS	28.0 -3.5, +5.5 vdc	0%
GG 1510 link 4	+28 vdc IMU STBY BUS	28.0 -6.0, +5.5 vdc ⊕	0% IMU STBY } ON only } ⊕
GG 1513X link 5	+28 vdc IMU STBY/OFF	28.0±1 vdc	0%
GG 1520 link 4	+28 vdc LGC Oper BUS	28.0 ±4.5 vdc	0%
GG 1523X link 5	+28 vdc LGC Operate	28.0±1 vdc	0%
GG 2001 link 5	X PIPA S.G. OUT IN PH	+2.5±0.128V rms at 1g	3%
GG 2021 link 5	Y PIPA S.G. OUT IN PH	+2.5±0.128V rms at 1g	3%
GG 2041 link 5	Z PIPA S.G. OUT IN PH	+2.5±0.128V rms at 1g	3%
GG 2106 link 4	IG Servo Error Total	0.0±60 MV rms at null	1%
GG 2107 link 5	IG Servo Error IN PH	0.0±60 MV rms at null	2%
GG 2110 link 4	IG Torque Motor Current	0.5 AMP Max during any fine Align Torque	0%
GG 2110 link 5	IG Torque Motor Current	0.5 AMP Max during any fine Align Torque	1%
GG 2112 link 5	IG 1X Resolver Out-Sine	18.4±1.84V rms at 45°	2.5%
GG 2113 link 5	IG 1X Resolver Out-Cosine	18.4±1.84V rms at 45°	2.5%
GG 2121 link 5	IG 1X Resolver Out-Sine 11°	5.35±0.27V rms at 11°	2%
GG 2136 link 4	MG Servo Error Total	0.0±60 MV rms at null	1%
GG 2137 link 5	MG Servo Error IN PH	0.0±60 MV rms at null	2%
GG 2140 link 4	MG Torque Motor Current	0.5 AMP Max during any fine Align Torque	0%
GG 2140 link 5	MG Torque Motor Current	0.5 AMP Max during any fine Align Torque	1%
GG 2142 link 5	MG 1X Resolver Out-Sine	18.4±1.84V rms at 45°	2.5%
GG 2143 link 5	MG 1X Resolver Out-Cosine	18.4±1.84V rms at 45°	2.5%
GG 2151 link 5	MG 1X Resolver Out-Sine 11°	5.35±0.27V rms at 11°	2%
GG 2166 link 4	OG Servo Error Total	0.0±60 MV rms at null	1%
GG 2167 link 5	OG Servo Error IN PH	0.0±60 MV rms at null	2%
GG 2170 link 4	OG Torque Motor Current	0.9 AMP Max during any fine Align Torque	0%
NG 1336 link 4	PH DIFF 3.2kc	0° ±10°	3%
GG1510 Link 4	28V/LGC SYNC +28 VDC IMU STBY BUS IMU STBY ON-IMU OPER ON	28.0 -4.5, +4.5 vdc	0%

APPENDIX I (Continued)

<u>SIGNAL</u>	<u>SIGNAL NAME</u>	<u>G&N LAB TEST REQUIREMENT</u>	<u>PSAAM AND/OR SCA UNCERTAINTY % OF FULL SCALE</u>
GG 2170 link 5	OG Torque Motor Current	0.9 AMP Max during any fine Align Torque	1%
GG 2172 link 5	OG 1X Resolver Out-Sine	18.4±1.84V rms at 45°	2.5%
GG 2173 link 5	OG 1X Resolver Out-Cosine	18.4±1.84V rms at 45°	2.5%
GG 2181 link 5	OG 1X Resolver Out-Sine 11°	5.35±0.27V rms at 11°	2%
GG 2219 link 5	Pitch Attitude Error	5.05±0.5V rms at 17°	1%
GG 2220 link 4	IG CDU Fine Error	0.0±0.07V rms at null	1%
GG 2221 link 4	IG CDU Coarse Error	0.0±0.68V rms at null	1%
GG 2249 link 5	YAW Attitude Error	5.05±0.5V rms at 17°	1%
GG 2250 link 4	MG CDU Fine Error	0.0±0.07V rms at null	1%
GG 2251 link 4	MG CDU Coarse Error	0.0±0.68V rms at null	1%
GG 2279 link 5	Roll Attitude Error	5.05±0.5V rms at 17°	1%
GG 2280 link 4	OG CDU Fine Error	0.0±0.07V rms at null	1%
GG 2281 link 4	OG CDU Coarse Error	0.0±0.68V rms at null	1%
GG 2300 link 5	PIPA Temperature	130.5±1.5°F in Operate	1%
GG 2301 link 4	IRIG Temperature	135±2.5°F in Operate	1%
GG 2301 link 5	IRIG Temperature	135±2.5°F in Operate	1%
GG 2302 link 4	IMU Heater Current On	28±1 vdc	0%
GG 2303 link 4	IMU Blower Current On	28±1 vdc	0%
GG 3304 link 5	RR Shaft 1X Resolver Out-Sine	19.65±0.98V rms at 45°	2.5%
GG 3305 link 5	RR Shaft 1X Resolver Out-Cosine	19.65±0.98V rms at 45°	2.5%
GG 3311 link 4	RR Shaft CDU Fine Error	0.0±0.07V rms at null	1%
GG 3312 link 4	RR Shaft CDU Coarse Error	0.0±0.68V rms at null	1%
GG 3321 link 4	RR Trunnion CDU Fine Error	0.0±0.07V rms at null	1%
GG 3322 link 4	RR Trunnion CDU Coarse Error	0.0±0.68V rms at null	1%
GG 3324 link 5	RR Trunnion 1X Resolver Out-Sine	19.65±0.98V rms at 45°	2.5%
GG 3325 link 5	RR Trunnion 1X Resolver Out-Cosine	19.65±0.98V rms at 45°	2.5%
GG 4300 link 4	LGC Temperature	87.5±42.5°F	0%
GG 6020 link 4	PIPA Calibration Module Temperature	67.5±22.5°F	0%
GG 6020 link 5	PIPA Calibration Module Temperature	67.5±22.5°F	0%
GG 6021 link 4	PSA Temperature	85±25.0°F	0%

~~Link 4 PIPA Calibration Module~~
~~Link 5 PIPA Calibration Module~~

<u>SIGNAL</u>	<u>SIGNAL NAME</u>	<u>G&N LAB TEST REQUIREMENT</u>	<u>PSAAM AND/OR SCA UNCERTAINTY OF FULL SCALE</u>
NG1021 link 4	14 VDC LGC Noise RMS	0.4 VRMS Max	0%
NG1022 link 4	14 VDC LGC Noise Peak	5 volts with rise time of 2 to 5 usec	0%
NG1031 link 4	4 VDC LGC Noise RMS	0.4 VRMS Max	0%
NG1032 link 4	4 VDC LGC Noise Peak	5 volts with rise time of 2 to 50 used	0%
NG1071 link 4	4 VDC CDU Noise RMS	1.0 VRMS Max	0%
NG1072 link 4	4 VDC CDU Noise Peak	5 volts with rise time of 2 to 50 usec	0%
NG1501 link 4	28 VDC IMU Operate Noise RMS	1.0 VRMS Max	0%
NG1502 link 4	28 VDC IMU Operate Noise Peak	5 volts with rise time of 2 to 50 usec	0%
NG1511 link 4	28 VDC IMU Standby Noise RMS	1.0 VRMS Max	0%
NG1512 link 4	28 VDC IMU Standby Noise Peak	5 volts with rise time of 2 to 50 usec	0%
NG1521 link 4	28 VDC LGC Operate Noise RMS	1.0 VRMS Max	0%
NG1522 link 4	28 VDC LGC Operate Noise Peak	5 volts with rise time of 2 to 50 usec	0%

*Link 4 - PSAAM Output Signal

**Link 5 - SCA Output Signal

ADDENDUM 1

LM-1 and LM-2

ADDITION 1: The following procedure will be performed for LM-1 and LM-2 only.

6.3.16 Gyrocompassing Test

6.3.16.1 Insure that the IMU Operate power and LGC Operate power has been applied for a minimum of one hour and that the IMU is not in a Gimbal Lock condition.

6.3.16.2 On K-148 enter the following sequence:

VERB 57 ENTR
00006 ENTR

6.3.16.3 VERB 06 NOUN 61 shall flash.

6.3.16.4 The CRT, DSKY display shall display Launch Azimuth. (Launch Azimuth shall be the GAEC Navigator Base Azimuth defined by GAEC).

6.3.16.5 If value for Row 1 is correct, proceed to the next step. If value for Row 1 is incorrect, enter the following into K-148:

VERB 21 ENTR
*XXXXX ENTR Correct launch azimuth (GAEC Nav Base Az)

Verify value in Row 1 is correct.

6.3.16.6 On K-148 enter the following:

VERB 33 ENTR

6.3.16.7 VERB 06 NOUN 61 shall flash.

6.3.16.8 The CRT, DSKY display shall display Navigation Base Azimuth and Latitude, respectively.

6.3.16.9 If the values for Row 1 and Row 2 are correct, proceed to the next step. If the values for Row 1 or Row 2 are incorrect, enter the following into K-148.

If Row 1 is incorrect: VERB 21 ENTR
±XXXXX ENTR (Correct Nav Base Azimuth)

If Row 2 is incorrect: VERB 22 ENTR
+40.748 ENTR (Correct Site Latitude)

Verify values for Row 1 and Row 2 are correct.

6.3.16.10 On K-148 enter the following:

VERB 33 ENTR
VERB 16 NOUN 20 ENTR

6.3.16.11 One hour after step 6.3.16.10 has been performed, read and record CRT DSKY display of Row 1, Row 2, and Row 3.

6.3.16.12 Obtain and record the latest measured value of the following data.

6.3.16.12.1 NBDX

6.3.16.12.2 NBDY

6.3.16.12.3 NBDZ

6.3.16.12.4 ADIAZ

6.3.16.12.5 ADSRAY

6.3.16.12.6 GAEC NB YZ plane about Z local vertical.

6.3.16.12.7 GAEC NB YZ plane about Y local vertical.

6.3.16.13 Calculate the vertical and east IRIG coefficient drift contribution to azimuth error (ϕ Vert).

a. Drift (vert) = $NBDZ + ADIAZ =$ _____ meru

b. Drift (east) = $NBDX \sin \alpha + NBDY \sin (\alpha + 90) + ADSRAY \sin (\alpha + 90)$
Where α = Launch Azimuth

c. ϕ vert = $\frac{6.65a + 272b}{3600} =$ _____ degrees

6.3.16.14 Algebraically add ϕ (vert) from the Row 1 DSKY display recorded in 6.3.16.11. The resultant azimuth error shall be 000.00 ± 000.57 degrees.

6.3.16.15 Algebraically subtract the value recorded in 6.3.16.12.6 from the Row 3 DSKY display recorded in 6.3.16.11. The resultant vertical error about Z local vertical shall be 000.00 ± 000.06 degrees.

6.3.16.16 Algebraically subtract the value recorded in 6.3.16.12.7 from the Row 2 DSKY display recorded in 6.3.16.11. The resultant vertical error about Y local vertical shall be 000.00 ± 000.06 degrees.

6.3.16.17 Two hours after 6.3.16.10 has been performed, read and record CRT DSKY display of Row 1, Row 2, and Row 3.

6.3.16.18 The CRT DSKY display of Row 1 shall be within 000.06 degrees of the value recorded in 6.3.16.11. The CRT DSKY display of Row 2 and Row 3 shall be within 000.03 degrees of the respective values recorded in 6.3.16.11.

6.3.16.19 On K-148 enter the following:

VERB 36		ENTR
VERB 40	NOUN 20	ENTR
+00000		ENTR
+00000		ENTR
+00000		ENTR

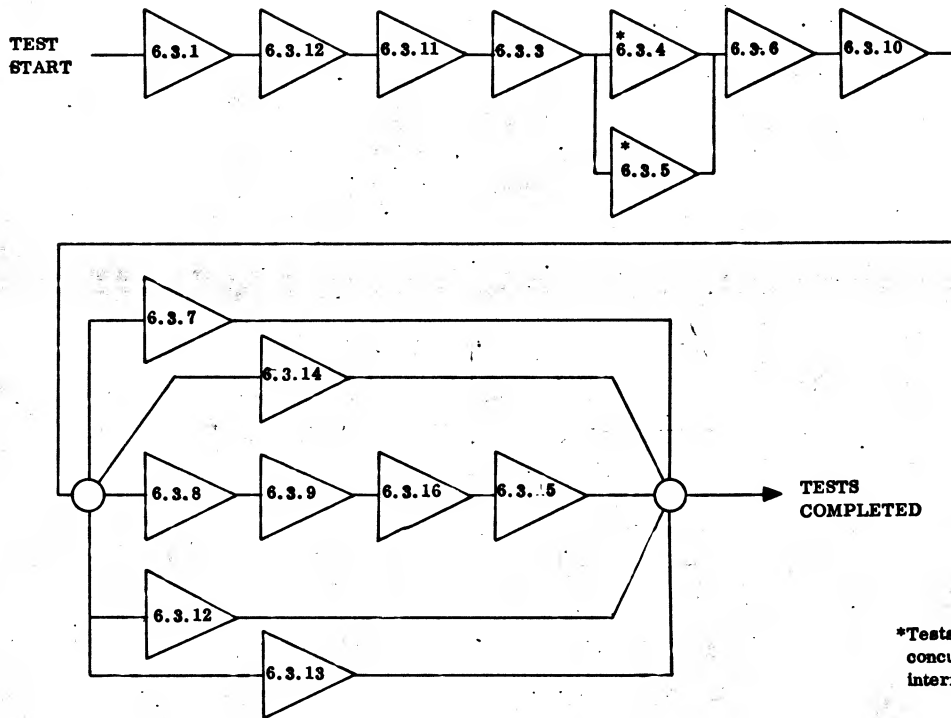
ADDENDUM 1

LM-1 and LM-2

Addition 2: Perform LM-1 and LM-2 test in accordance with the following Flowgram.

Addition 3: Place a note after paragraph 6.3.1.6.2.

NOTE: If the LMP Interlock CB is energized insure that the ATCA switch on LEM Panel 16 and the ATCA/PGNCS switch on Panel 11 are in the off position before performing the following steps.



TEST PROCEDURE FLOWGRAM

FIGURE 1

*Tests may be performed
concurrently on a non-
interference basis

ADDENDUM II
AURORA 85

Following are the changes required to make this document applicable for checkout of a G&N System with an Aurora 85 Test Rope.

Addition 1. Paragraph 6.3.7 PGNCs Operational Test

- a. Delete paragraphs 6.3.7.15.2 and 6.3.7.15.3
- b. Subtract an Octal 1 from each of the NOUN display requirements in paragraphs 6.3.7.20.1, 6.3.7.20.3, 6.3.7.20.5, 6.3.7.20.7, 6.3.7.20.9, 6.3.7.20.11 and 6.3.7.20.13.

Addition 2. Paragraph 6.3.8 IRIG Scale Factor Test

- a. Change Paragraph 6.3.8.22 to read as follows:

The average of the three readings of Scale Factor Error for each of the 6 positions shall be 556 ± 1750 PPM.

Addition 3. Paragraph 6.3.9 IMU Performance Test.

- a. Add the following note prior to step 6.3.9.22.

NOTE: Paragraph 6.3.9.24 must be performed within one minute after VERB 06 and NOUN 66 flash in paragraph 6.3.9.23. In the event a PROG alarm is obtained enter VERB 36, press the ENTR pushbutton and repeat paragraphs 6.3.9.8 through 6.3.9.24.

- b. Add the following note prior to step 6.3.9.36.

NOTE: Paragraph 6.3.9.39 must be performed within one minute after VERB 06 and NOUN 66 flash in paragraph 6.3.9.38. In the event a PROG alarm is obtained enter VERB 36, press ENTR and repeat paragraphs 6.3.9.8 through 6.3.9.1. Enter the following in K-148.

VERB 25	ENTR
+00600	ENTR
+00000	ENTR
+00003	ENTR

Repeat paragraphs 6.3.9.28 through 6.3.9.39.

6.3.17.4.4 On K-148 enter the following:

Press ERR RST
VERB 36 ENTR
VERB 41 NOUN 40 ENTR
+00000 ENTR
+03375 ENTR
VERB 34 ENTR
VERB 21 NOUN 10 ENTR
00012 ENTR
00001 ENTR

Verify RR CDU Fail comes ON in approximately 90 seconds.

ADDENDUM III RR INTERFACE
LTA-8, (MSC) - LM-3 and Subsequent

RR CDU testing requires that the Rendezvous Radar is operating. The Rendezvous Radar is not activated until Integrated testing. To insure that the RR CDU's are operating properly the minimum requirements for RR CDU testing are presented here so that they may be included as part of the requirements to be demonstrated at the first opportunity after Rendezvous Radar activation.

6.3.17 RR/CDU Control

6.3.17.1 Command Accuracy 24000°

6.3.17.1.1 On K-148 enter the following

VERB 36	ENTR
VERB 41 NOUN 40	ENTR
+24000	ENTR
+24000	ENTR
VERB 34	ENTR

The CRT RR CDU Trunnion and Shaft angle indications shall be $240.00 \pm 000.30^\circ$.

6.3.17.2 CDU Fine and CDU Coarse Error

6.3.17.2.1 Set up analog recorder to monitor the following:

<u>Meas. No.</u>	<u>Signal Name</u>
a. GG3311	Shaft CDU Fine Error
b. GG3312	Shaft CDU Coarse Error
c. GG3321	Trunnion CDU Fine Error
d. GG3322	Trunnion CDU Coarse Error

6.3.17.2.2 On K-148 enter the following:

VERB 36	ENTR
VERB 41 NOUN 40	ENTR
+04500	ENTR
+04500	ENTR
VERB 34	ENTR

6.3.17.2.3 Verify the following signals on the CRT.

RR Shaft 1X Sin (GG3304)	18.4±1.84 VRMS
RR Shaft 1X Cos (GG3305)	18.4±1.84 VRMS
RR Trunnion 1X Sine (GG3324)	18.4±1.84 VRMS
RR Trunnion 1X Cos (GG3325)	18.4±1.84 VRMS

- 6.3.17.2.4 Verify that no CDU Fine Error (GG3311, GG3321) exceeds .070 volts.
- 6.3.17.2.5 Verify that no CDU Coarse Error (GG3312, GG3322) exceeds .680 volts.
- 6.3.17.3 Deleted.
- 6.3.17.3.1 Deleted.
- 6.3.17.3.2 Deleted.

VERB 40 NOUN 40 ENTR

Wait 10 seconds then record the CRT RR CDU Trunnion and Shaft indications;
the recorded value shall be within $\pm 0.01^\circ$ of the value recorded above.

6.3.17.4 RR CDU Fail

- 6.3.17.4.1 On K-148 Enter the following:

VERB 36 ENTR
VERB 41 NOUN 40 ENTR
+00100 ENTR
+00000 ENTR
VERB 34 ENTR
VERB 21 NOUN 10 ENTR
00012 ENTR
00001 ENTR

Verify RR CDU Fail comes ON in approximately 10 seconds.

- 6.3.17.4.2 On K-148 enter the following:

Press ERR RST
VERB 36 ENTR
VERB 41 NOUN 40 ENTR
+00000 ENTR
+00100 ENTR
VERB 34 ENTR
VERB 21 NOUN 10 ENTR
00012 ENTR
00001 ENTR

Verify RR CDU Fail comes ON in approximately 10 seconds.

6.3.17.4.3 On K-148 enter the following:

Press ERR RST		
VERB 36		ENTR
VERB 41	NOUN 40	ENTR
+03375		ENTR
+00000		ENTR
VERB 34		ENTR
VERB 21	NOUN 10	ENTR
00012		ENTR
00001		ENTR

Verify RR CDU Fail comes ON in approximately 10 seconds.

6.3.17.4.4 On K-148 enter the following:

Press ERR RST		
VERB 36		ENTR
VERB 41	NOUN 40	ENTR
+00000		ENTR
+03375		ENTR
VERB 34		ENTR
VERB 21	NOUN 10	ENTR
00012		ENTR
00001		ENTR

Verify RR CDU Fail comes ON in approximately 10 seconds.

6.3.17.4.5 On K-148 enter the following:

Press ERR RST		
VERB 36		ENTR
VERB 41	NOUN 40	ENTR
+00000		ENTR
+00000		ENTR
VERB 34		ENTR

ADDENDUM IV

LM-4 and Subsequent Spacecraft Measurement Deletions

- Addition 1: Delete last sentence of Paragraph 6.3.4.2.
- Addition 2: Delete last two sentences of Paragraph 6.3.4.3.
- Addition 3: Delete Paragraphs 6.3.7.23 and 6.3.7.24.
- Addition 4: Change Paragraph 6.3.7.25 to read as follows:
- 6.3.7.25 On K-148, enter the following:
VERB 36 ENTR
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR
- Addition 5: Delete the reference to IRIG temperature from the following Paragraphs:
- Page 41, Paragraph 6.3.8.2
Page 43, Paragraph 6.3.9.2
Page 49, Paragraph 6.3.9.68
Page 67, Paragraph 6.3.12.1.4b
Page 92, Appendix 1.

APOLLO G&N Specification
 ND1002323 REV N
 Original Issue Date:
 Release Authority: TDRR
 Class A Release

POST-INSTALLATION CHECKOUT SPECIFICATION
 FOR LM G&N SYSTEM

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
11/27/68	L	37063	7, 24, 35, 60, 76, 81 Total No. pages now 106.	EA	WLS
3/27/69	M	37452	14, 20-22, 43-105, Was 105 pages, now 109 pages.	EA	RJJ
6/18/69	N	37620	20-68	EA	--

This specification consists of page 1 to 109 inclusive.

APPROVALS	W.S. Swingle	MIT/IL	R.D. Petryk	J.F. Pizzala
	NASA/MSO		D.A. Ziemer AC	
				9/23/66

6.3.1.6.5.3 When R3 = 00002, stop the LGC Self Check by entering the K-148 in the following:

VERB 34 ENTR
VERB 21 NOUN 27 ENTR
00000 ENTR

6.3.1.6.6 LGC Standby Check

6.3.1.6.6.1 On K-148, enter the following sequence:

VERB 21 NOUN 17 ENTR
+00000 ENTR

Start ACE Countdown clock upon depressing ENTR from an initial setting of 0 HRS, 0 MIN, 0 SEC. Record difference between LGC time on the CRT and the Countdown clock.

VERB 00 ENTR
Verify on CRT ABL-LGC-STBY is ON

6.3.1.6.6.2 On DSKY depress PRO pushbutton for approximately 3 seconds.

6.3.1.6.6.3 Verify STBY status indicator lamp is ON.

6.3.1.6.6.4 On the CRT, verify the 3.2 KC 28V Supply (GG1331) is between 28.04 and 29.16V RMS.

6.3.1.6.6.5 On DSKY depress PRO pushbutton for approximately 3 seconds to return to LGC OPERATE mode. If the LGC does not return to the OPERATE mode, depress the PRO pushbutton for a maximum of two additional times.

6.3.1.6.6.6 Verify STBY status indication lamp is OFF. RESTART light may be ON, verify LGC WARNING OFF. Press ERROR RESET pushbutton. Enter VERB 61 ENTR on K-148. Verify on CRT ABL-LGC-STBY is OFF. Record LGC time on the CRT and time displayed on the countdown clock simultaneously. Verify that the difference between the LGC time and countdown clock is within one second of the difference recorded in 6.3.1.6.6.1.

6.3.1.6.7 Standby/Proceed Check

6.3.1.6.7.1 On K-148 enter the following:

VERB 11 NOUN 10 ENTR
00032 ENTR

6.3.1.6.7.2 On the DSKY press and hold the PRO pushbutton. Verify Row 1 of the DSKY displays 57777.

6.3.2 Alarms and Interrupts Test

6.3.2.1 Parity Fail Test

6.3.2.1.1 On K-148 enter the following sequence

VERB 24 NOUN 01 ENTR
01600 ENTR
33777 ENTR
04353 ENTR

6.3.2.1.2 On CRT, DSKY display, verify R1 = 33777 and R3 = 01600

6.3.2.1.3 On K-148 enter the following sequence

VERB 25 NOUN 26 ENTR
04000 ENTR
01600 ENTR
00003 ENTR
VERB 30 ENTR

6.3.2.1.4 Verify RESTART lamp is ON; PARITY lamp is ON.

6.3.2.1.5 On K-148 enter VERB 36 ENTR. Press ERROR RESET pushbutton. All alarms shall clear.

6.3.2.2 Rupt Lock-Interrupt Too Long

6.3.2.2.1 On K-148 enter the following sequence.

VERB 25 NOUN 01 ENTR
01600 ENTR
00004 ENTR
30067 ENTR
01600 ENTR
VERB 25 NOUN 26 ENTR
00001 ENTR
01600 ENTR
00003 ENTR
VERB 31 ENTR

6.3.2.3.6 On K-148 enter VERB 36 ENTR. Press ERROR RESET pushbutton. All alarms shall clear.

6.3.2.4 Nightwatchman Test

6.3.2.4.1 On K-148 enter the following sequence

VERB 24	NOUN 01	ENTR	03400	ENTR
01600		ENTR	01600	ENTR
30001		ENTR	00003	ENTR
01600		ENTR	VERB 30	ENTR
VERB 25	NOUN 26	ENTR		

6.3.2.4.2 Verify RESTART lamp is ON.

6.3.2.4.3 On K-148 enter VERB 36 ENTR. Press ERROR RESET pushbutton. All alarms shall clear.

- 6.3.5.2 The PIPA Calibration Module Temperature (GG6020) shall be between +45 and +90 DEG F.
- 6.3.5.3 The PSA Temperature (GG6021) shall be between +60 and +110 DEG F.
- 6.3.5.4 The LGC Temperature (GG4300) shall be between +45 and +130 DEG. F.
- 6.3.5.5 The +28 VDC IMU OPERATE BUS (GG1500) shall be between 24.5 and 33.5 VDC.
- 6.3.5.6 The +28 VDC IMU STANDBY BUS (GG1510) shall be between 23.5 and 32.5 VDC.
- 6.3.5.7 The +28 VDC LGC OPERATE BUS (GG1520) shall be between 23.5 and 32.5 VDC.
- 6.3.5.8 The +120 VDC PIPA Supply (GG1040) shall be between 114 and 126 VDC.
- 6.3.5.9 The -28 VDC Supply (GG1100) shall be between -21.5 and -33.5 VDC.
- 6.3.5.10 The +4 VDC CDU Supply (GG1070) shall be between 3.8 and 4.2 VDC.
- 6.3.5.11 The IMU 28V 800 CPS 1 pct Supply (GG1201) shall be between 27.44 and 28.56 VRMS.
- 6.3.5.12 The IMU 28V 800 CPS 5 pct 90 PH Supply (GG1202) shall be between 26.6 and 29.4 VRMS.
- 6.3.5.13 The IMU 28V 800 CPS 5 pct 0 PH Supply (GG1203) shall be between 25.9 and 30.1V RMS.
- 6.3.5.14 The 3.2 KC 28V Supply (GG1331) shall be between 28.04 and 29.16V RMS.
- 6.3.5.15 The 2.5 VDC T/M Bias (GG1110) shall be between 2.44 and 2.56 VDC.
- 6.3.5.16 The +14 VDC LGC Supply (GG1020) shall be between 13.6 and 14.4 VDC.
- 6.3.5.17 The +4 VDC LGC Supply (GG1030) shall be between 3.8 and 4.2 VDC.
- 6.3.5.18 The phase difference between the 3.2 KC supply and LGC sync shall be $0^\circ \pm 10^\circ$ (NG1336).

6.3.6.3 Perform the following calculations:

a. $\frac{BBBB \times 5.12}{3600} = CCCC.C$ (Contents (hrs) of high order scalar register)

b. $23.3 - CCCC.C = DDDD.D$ hours

c. $DDD.D + \text{time of day recorded in 6.3.6.1} = \text{time of day at which high order scalar register will overflow.}$

6.3.6.4 If time of day is within 12 minutes of that calculated in 6.3.6.3.c when about to perform any of the following paragraphs, wait until that time calculated in 6.3.6.3.c has passed and proceed.

6.3.6.5 In K-148 enter the following sequence:

```
VERB 41 NOUN 20 ENTR
+00000          ENTR
+00000          ENTR
+00000          ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+17000          ENTR
+17000          ENTR
+17000          ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+27000          ENTR
+27000          ENTR
+27000          ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+00000          ENTR
+00000          ENTR
+00000          ENTR
Wait 15 seconds
VERB 57          ENTR
00004           ENTR
```

6.3.6.6 Wait 200 seconds, then verify on the CRT, that the X, Y and Z PIPA SG Output signals all indicate 0.0 ± 2.5 Volts but not 0.

6.3.6.7 Approximately 12 minutes after performing step 6.3.6.1, VERB 06 NOUN 66 shall flash.

6.3.9.70 Calculations

NOTE: Use Post Vibration or System Test data points only.

6.3.9.70.1 Y PIPA Data Correction Calculation

6.3.9.70.1.1 From the uplink file tape, the compressed data tape or the PCM tape, request a data reduction of the X and Z accelerometer ΔV counts (addresses 37 and 41, respectively) and the TIME 2 and TIME 1 registers (addresses 24 and 25, respectively) for the period during which the Y PIPA test was being performed in positions 5 and 6 of the IMU Performance test.

6.3.9.70.1.2 Perform the following calculations for position 5.

$$G_5' = \frac{G_5}{\cos \theta y_5}$$

where:

G_5' = Measured acceleration term (line k)

G_5 = Corrected acceleration term (line k)

$$\cos \theta y_5 = 1 - \frac{\theta^2 y_5}{2} \text{ (for small angles)}$$

where:

$$\theta y_5 = \sqrt{\theta^2 x_5 + \theta^2 z_5}$$

and:

$$\theta z_5 = \frac{(\Delta V_{z5} - \Delta V_z \text{ Bias}) (S.F._z)}{(\Delta T) (\text{local } g)}$$

$$\theta x_5 = \frac{(\Delta V_{x5} - \Delta V_x \text{ Bias}) (S.F._x)}{(\Delta T) (\text{local } g)}$$

and:

$$\Delta V_x \text{ Bias} = \frac{(X \text{ PIPA Bias}) (\Delta T)}{S.F._x}$$

$$\Delta V_z \text{ Bias} = \frac{(Z \text{ PIPA Bias}) (\Delta T)}{S.F._z}$$

S.F. and Bias terms are obtained from positions 1 through 4 of the IMU Performance Test.

6.3.9.70.1.3 Perform the following calculations for position 6.

$$G'_6 = \frac{G_6}{\cos \theta y_6}$$

where:

G_6 = Measured acceleration term

G'_6 = Corrected acceleration term (line 6)

$\cos \theta y_6 = 1 - \frac{\theta^2 y_6}{2}$ (for small angles)

$$\theta y_6 = \sqrt{\theta^2 x_6 + \theta^2 z_6}$$

and:

$$\theta z_6 = \frac{(\Delta V x_6 - \Delta V x \text{ Bias}) (S.F. x)}{(\Delta T) (\text{local } g)}$$

$$\theta x_6 = \frac{(\Delta V z_6 - \Delta V z \text{ Bias}) (S.F. z)}{(\Delta T) (\text{local } g)}$$

and:

$$\Delta V_x \text{ Bias} = \frac{(X \text{ PIPA Bias}) (\Delta T)}{S.F. x}$$

$$\Delta V_z \text{ Bias} = \frac{(Z \text{ PIPA Bias}) (\Delta T)}{S.F. z}$$

S.F. and Bias terms are obtained from positions 1 through 4 of the IMU Performance Test.

- 6.3.9.70.2 Obtain data from last IRIG and/or PIPA test and fill in Data Sheet x_{i-1} .
- 6.3.9.70.3 Obtain data from second last IRIG and/or PIPA test and fill in Data Sheet x_{i-2} .
- 6.3.9.70.4 Obtain data from third last IRIG and/or PIPA test and fill in Data Sheet x_{i-3} .
- 6.3.9.70.5 Perform the following calculations for each item appearing on Data Sheet x_i and transfer all results to lines au through bl.

NOTE:

See paragraph 5.6 before continuing

$$D_1 = |x_{i-1} - x_i|$$

$$D_2 = |x_{i-1} - x_i| + |x_{i-2} - x_{i-1}|$$

$$D_3 = |x_{i-3} - x_{i-2}| + |x_{i-2} - x_{i-1}| + |x_{i-1} - x_i|$$

6.3.10 LGC Voltage Margin Test

6.3.10.1 Initial Conditions

6.3.10.1.1 Insure that the G&N System is in the Standby Mode

6.3.10.1.2 On the CRT, verify the +28 VDC LGC OPERATE bus is between 23.5 and 32.5 vdc (GG 1520).

6.3.10.1.3 Rotate the ANNUN/NUM dimmer control for minimum readable EL brightness. Insure that the ANUN OVERRIDE switch is OFF.

6.3.10.2 Voltage Margin Determination.

6.3.10.2.1 On the PSA Adapter Module (PSAAM) (410-31080), place INHIBIT VOLTAGE FAIL switch to ON.

CAUTION: The +4 VDC LGC Supply voltage shall never be operated lower than +2.5 vdc or higher than +5.2 vdc (GG1030).

The +14 VDC LGC Supply shall never be operated less than +8.5 vdc or higher than +17.0 vdc (GG1020). LTG-ANUN/NUM Control on panel 5 shall be set to DIM during the performance of the Voltage Margin Test in order to avoid decreasing the operating life of the DSKY EL lamps.

NOTE: The flashing indication of the LGC supplies may be disregarded for this test. The charts in Figure 2 may be used to determine approximate values for "XX.X" values of C-156 voltage dial settings corresponding to various power supply voltages.

DATA SHEET

ITEM NO.	PARAMETER	UNITS	RECORDED VALUE	
6.3.9.11	+N BDY Position +00001 Transfer result to line af	meru	() ---.--	a.
6.3.9.17	+X PIPA Test Position +00001	cm/sec ²	() 00---. () ----	b.
6.3.9.21	+N BDZ Position +00002 Transfer result to line ag	meru	() ---.--	c.
6.3.9.23	-X PIPA Test Position +00002	cm/sec ²	() 00---. () ----	d.
6.3.9.25	-N BDX + ADIAX Position +00002	meru	() ---, --	e.
6.3.9.29	-N BDX Position +00003 Multiply by -1 and transfer result to line ah	meru	() ---.--	f.
6.3.9.31	+Z PIPA Test Position +00003	cm/sec ²	() 00---. () ----	g.
6.3.9.35	+N BDY + ADSRAY Position +00004	meru	() ---.--	h.
6.3.9.38	-Z PIPA Test Position +00004	cm/sec ²	() 00---. () ----	i.
6.3.9.40	+N BDZ + ADIAZ Position +00004	meru	() ---.--	j.
6.3.9.45	+Y PIPA Test Position +00005	cm/sec ²	() 00---. () ----	k.
6.3.9.50	-Y PIPA Test Position +00006	cm/sec ²	() 00---. () ----	l.

DATA SHEET

ITEM NO.	PARAMETER	UNITS	RECORDED VALUE
6.3.9.54	-NBDX+ .707 ADSRAX Position +00007	meru	
6.3.9.58	-.707 (NBDZ+NBDY) +.5 (ADIAZ-ADIA Y) +.5 (ADSRAY+ADSRAZ) Position +00008	meru	
6.3.9.62	-NBDZ+.707ADSRAZ Position +00009	meru	
6.3.9.66	.707(NBDY-NBDX) +.5 (ADIAZ-ADIA X) +.5 ADSRAX Position +00010	meru	

m.

n.

o.

p.

DATA SHEET

CALCULATION	PARAMETER	UNITS	
line e - line f = () ---.-- (-NBDX+ADIAX) - (-NBDX) Transfer result to line ai.	ADIAX	meru/g	q
line h - line a = () ---.-- (+NBDY+ADSRAY) - (+NBDY) Transfer result to ai.	ADSRAY	meru/g	r
line j - line c = () ---.-- (+NBDZ+ADIAZ) - (NBDZ) Transfer result to line am.	ADIAZ	meru/g	s
(line m - line f) X 1.414 = () ---.-- [(-NBDX + .707 ADSRAX) - (-NBDX)] X 1.414 Transfer result to line ak.	ADSRAX	meru/g	t
(line o + line c) X 1.414 = () ---.-- (-NBDZ + .707 ADSRAZ + NBDZ) X 1.414 Transfer result to line ai.	ADSRAX	meru/g	u
(line p - .707 line a - .707 line f + .5 line q - .5 line t) X2 = ---.-- [.707 (NBDY-NBDX) + .5 (ADIAZ-ADIAX) + .5 ADSRAX - .707 (-NBDX) - .707 NBDY + .5 ADIAZ - .5 ADSRAZ] X2 Transfer result to line an.	ADIAZ	meru/g	v
line b - line d = ()	PIPA X2G	cm/sec ²	w
line k - line l = ()	PIPA Y2G	cm/sec ²	x
line g - line i = ()	PIPA Z2G	cm/sec ²	y
1960.52 ÷ line w x 1 cm/sec/pulse = Subtract 1.000000 from this value, multiply x 10 ⁶ and transfer results to line ao.	X PIPA S. F.	cm/sec/ pulse	z
1960.52 ÷ line x X 1 cm/sec/pulse = Subtract 1.000000 from this value, multiply x 10 ⁶ and transfer results to line ap.	Y PIPA S. F.	cm/sec/ pulse	aa
1960.52 ÷ line y X 1 cm/sec/pulse = Subtract 1.000000 from this value, multiply x 10 ⁶ and transfer results to line aq.	Z PIPA S. F.	cm/sec/ pulse	ab
1/2 (line b + line d) = () ---.-- Transfer results to line ar	X PIPA Bias	cm/sec ²	ac
1/2 (line k + line l) = () ---.-- Transfer results to line as	Y PIPA Bias	cm/sec ²	ad
1/2 (line g + line i) = () ---.-- Transfer results to line at	Z PIPA Bias	cm/sec ²	ae

TABLE V

Y	Y'
0	2
1	3
2	2
3	3
4	6
5	7
6	6
7	7

DATA SHEET
(x₁)

PARAMETER	UNITS	MIN VALUE	RECORDED VALUE	MAX VALUE	REJ	ACC
NBDY	meru	-15		+15		
NBDZ	meru	-15		+15		
NBDX	meru	-15		+15		
ADSRAY	meru/g	-40		+40		
ADSRAZ	meru/g	-40		+40		
ADSRAX	meru/g	-40		+40		
ADIAX	meru/g	-100		+100		
ADIAZ	meru/g	-100		+100		
ADIA Y	meru/g	-100		+100		
X PIPA S. F. error from line z	PPM	-1900		+1900		
Y PIPA S. F. error from line aa	PPM	-1900		+1900		
Z PIPA S. F. error from line ab	PPM	-1900		+1900		
X PIPA Bias from line ac	cm/sec ²	-3.1		+3.1		
Y PIPA Bias from line ad	cm/sec ²	-3.1		+3.1		
Z PIPA Bias from line ae	cm/sec ²	-3.1		+3.1		

af
ag
ah
ai
aj
ah
al
am
an
ao
ap
aq
ar
as
at

DATA SHEET
(1-1)

PARAMETER	UNITS	RECORDED VALUE
NBDY	meru	
NBDZ	meru	
NBDX	meru	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADSRAX	meru/g	
ADMAX	meru/g	
ADIAZ	meru/g	
ADIA Y	meru/g	
X PIPA S. F. error	PPM	
Y PIPA S. F. error	PPM	
Z PIPA S. F. error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

DATA SHEET
(x₁-2)

PARAMETER	UNITS	RECORDED VALUE
NBDY	meru	
NBDZ	meru	
NBDX	meru	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADSRAX	meru/g	
ADMAX	meru/g	
ADIAZ	meru/g	
ADIAZ	meru/g	
ADIAZ	meru/g	
X PIPA S. F. error	PPM	
Y PIPA S. F. error	PPM	
Z PIPA S. F. error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

DATA SHEET
(x₁₋₃)

PARAMETER	UNITS	RECORDED VALUE
NBDY	meru	
NBDZ	meru	
NBDX	meru	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADSRAX	meru/g	
ADIAX	meru/g	
ADIAZ	meru/g	
ADIAZ	meru/g	
X PIPA S. F. error	PPM	
Y PIPA S. F. error	PPM	
Z PIPA S. F. error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

DATA SHEET

PARAMETER	UNITS	D ₁	MAX	D ₂	MAX	D ₃	MAX	
NBDY	meru		6.0		9.0		11.0	au
NBDZ	meru		6.0		9.0		11.0	av
NBDX	meru		6.0		9.0		11.0	aw
ADSRAY	meru/g		14.0		21.0		25.0	ax
ADSRZ	meru/g		14.0		21.0		25.0	ay
ADSRAX	meru/g		14.0		21.0		25.0	az
ADIAX	meru/g		17.0		33.0		40.0	ba
ADIAZ	meru/g		17.0		33.0		40.0	bb
ADIAZ	meru/g		17.0		33.0		40.0	bc
X PIPA S. F.	Error PPM		400		500		600	bd
Y PIPA S. F.	Error PPM		400		500		600	be
Z PIPA S. F.	Error PPM		400		500		600	bf
X PIPA Bias	cm/sec ²		0.50		0.70		0.90	bg
Y PIPA Bias	cm/sec ²		0.50		0.70		0.90	bh
Z PIPA Bias	cm/sec ²		0.50		0.70		0.90	bi

- 6.3.10.2.2 On C-156, insert +025141114. Execute and verify.
- 6.3.10.2.3 Enter 1100 into R-153. Execute and verify.
- 6.3.10.2.4 Enter 0001 into R-155. Execute and verify.
- 6.3.10.2.5 Enter in C-156, $\pm XX.X141114$. (From Figure 2, enter a value for XX.X which will adjust the +14 VDC power supply as monitored on the CRT to a value as close to but not greater than 16.4 vdc.) Execute.
- 6.3.10.2.6 On PSAAM, set INHIBIT VOLTAGE FAIL switch OFF. Verify RESTART lamp on DSKY is lighted.
- 6.3.10.2.7 On PSAAM, set INHIBIT VOLTAGE FAIL switch ON. On DSKY depress RSET pushbutton and verify RESTART light is OFF.
- 6.3.10.2.8 Enter in C-156, $\pm XX.X141114$. (From Figure 2, enter a value for XX.X which will adjust the +14 VDC power supply as monitored on the CRT to a value as close to but not lower than 12.2 vdc.) Execute.
- 6.3.10.2.9 On PSAAM, set INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on DSKY is lighted.
- 6.3.10.2.10 On PSAAM, set INHIBIT VOLTAGE FAIL switch to ON. On DSKY depress RSET pushbutton and verify RESTART light is OFF.
- 6.3.10.2.11 On C-156, insert +000001114. Execute and verify.
- 6.3.10.2.12 On C-156, insert +030041124. Execute and verify.
- 6.3.10.2.13 Enter in C-156, $\pm XX.X041124$. (From Figure 2, enter a value for XX.X which will adjust the +4 VDC power supply as monitored on the CRT to a value as close to but not greater than +4.60 vdc.) Execute.
- 6.3.10.2.14 On PSAAM, set INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on DSKY is lighted.
- 6.3.10.2.15 On PSAAM, set INHIBIT VOLTAGE FAIL switch to ON. On DSKY, depress RSET pushbutton and verify RESTART light is off.
- 6.3.10.2.16 Enter in C-156, $\pm XX.X041124$. (From Figure 2, enter a value for XX.X which will adjust the +4 VDC power supply as monitored on the CRT to a value as close to but not lower than +3.50 vdc.) Execute.
- 6.3.10.2.17 On PSAAM, set INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on DSKY is lighted.
- 6.3.10.2.18 On PSAAM, set INHIBIT VOLTAGE FAIL switch to ON. On DSKY, depress RSET pushbutton and verify RESTART light is off.

6.3.10.2.19 On C-156, insert $\pm XX.X141114$. (From Figure 2, enter a value for XX.X which will adjust the +14 VDC power supply to a value as close to but not lower than +12.2 vdc.) Execute.

6.3.10.2.20 On K-148, insert:

```
VERB 21 NOUN 01 ENTR
01362          ENTR
00000          ENTR
```

6.3.10.2.21 Verify on CRT that REDOCTR reads +00000.

6.3.10.2.22 On K-148, insert

```
ERR RSET      PRESS
VERB 21 NOUN 27 ENTR
77767         ENTR
```

6.3.10.2.23 After 200 seconds, verify RESTART lamp on DSKY is off.

6.3.10.2.24 On C-156, insert $\pm XX.X141114$. (From Figure 2, enter a value for XX.X which will adjust the +14 VDC power supply as monitored on the CRT to a value as close to but not greater than +16.4 vdc.) Execute.

6.3.10.2.25 After 200 seconds, verify RESTART lamp on DSKY is off.

6.3.10.2.26 On C-156, enter $\pm XX.X041124$. (From Figure 2, enter a value for XX.X which will adjust the +4 VDC power supply as monitored on the CRT to a value as close to but not greater than +4.60 vdc.) Execute.

6.3.10.2.27 After 200 seconds, verify RESTART lamp on DSKY is off.

6.3.10.2.28 On C-156, enter $\pm XX.X141114$. (From Figure 2 enter a value for XX.X which will adjust the +14 VDC power supply as monitored on the CRT to a value as close to but not lower than +12.2 vdc.) Execute.

6.3.10.2.29 After 200 seconds, verify RESTART lamp on DSKY is off.

6.3.10.2.30 On K-148, insert:

```
VERB 21 NOUN 27 ENTR
0000          ENTR
Press Error Reset
```

6.3.10.2.31 On R-155, insert 0000. Execute and verify.

6.3.10.2.32 On R-153, insert 0000. Execute and verify.

6.3.10.2.33 On C-156, insert +000001114. Execute and verify.

6.3.10.2.34 On C-156, insert +000001124. Execute and verify.

6.3.10.2.35 On PSAAM, set INHIBIT VOLTAGE FAIL switch to OFF.

6.3.11 LGC Clock Frequency Test

6.3.11.1 Insure that LGC Operate power has been applied for a minimum of 10 minutes before performing this test.

6.3.11.2 Verify that the counter is connected to the 3.2kc signal on the hardline.

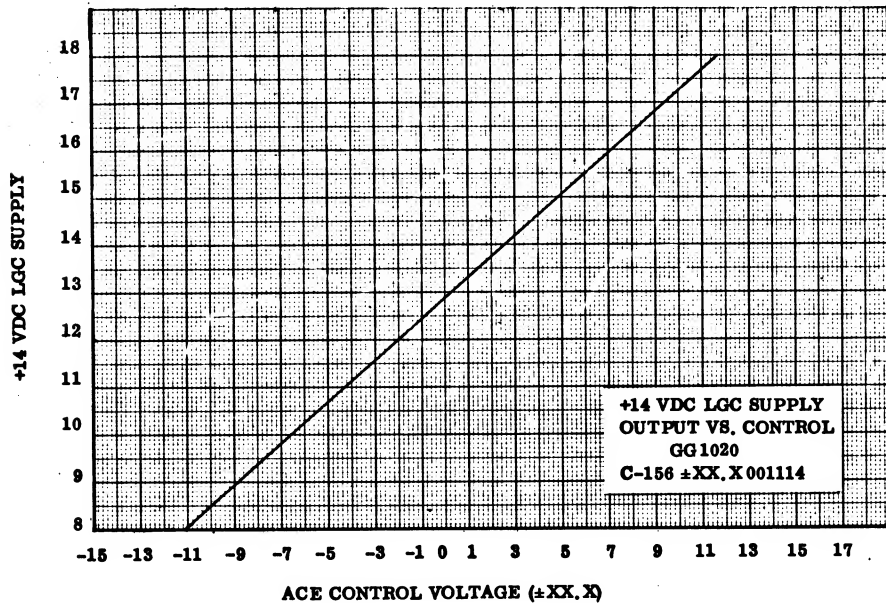
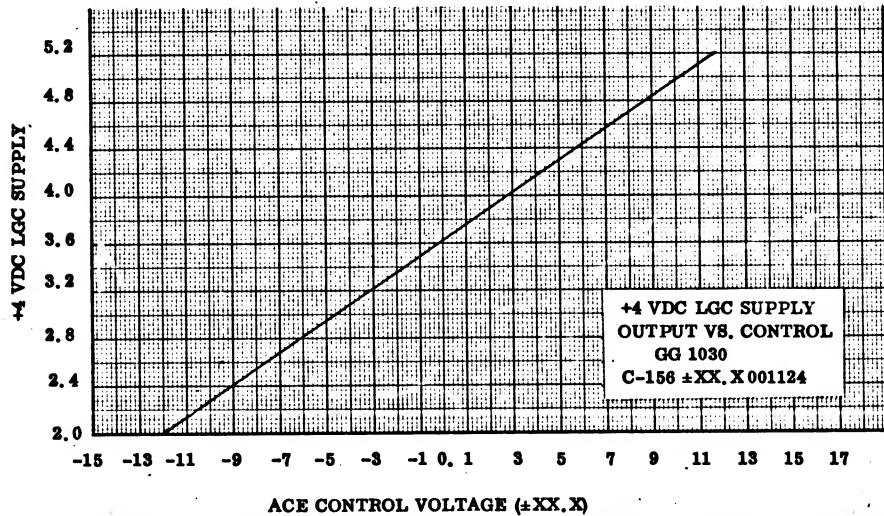


FIGURE 2

APOLLO G&N Specification
 ND1002323 REV P
 Original Issue Date:
 Release Authority: TDRR
 Class A Release

POST-INSTALLATION CHECKOUT SPECIFICATION
 FOR LM G&N SYSTEM

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				ACT	NASA
(P) 11/27/68	L	37063	7, 24, 35, 60, 76, 81 Total No. pages now 106.	EA	WLS
(P) 3/27/69	M	37452	14, 20-22, 43-105, Was 105 pages, now 109 pages.	EA	RJJ
(M) 6/18/69	N	37620	20-68	EA	--
11/6/69	P	37912	54 - 109. Was 109 pages; now 114.	EA	MDH

This specification consists of page 1 to 114 inclusive.

APPROVALS	W. S. Swingle	MIT/IL	R. D. Petryk	J. F. Pizzala
	NASA/MSC		D. A. Ziemer AC	9/23/66

6.3.15.11.7 Rotate the AOT control knob until the center of the R target reticle is superimposed between the double SPIRAL reticle lines. Record the AOT dial indication as FRS = XXX, XX.

6.3.15.11.8 On the DSKY enter:

±XXX,XX ENTR (FRY from 6.3.15.11.6)

Observe VERB 22 NOUN 42 flashing.

±XXX,XX ENTR (FRS from 6.3.15.11.7)

Observe VERB 51 flashing and R1 = 00002.

6.3.15.11.9 On the Computer Control and Reticle Dimming Assembly, press MARK X push-button.

6.3.15.11.10 Observe VERB 21 NOUN 30 flashing on DSKY.

6.3.15.11.11 On the DSKY enter:

00000 ENTR

Observe VERB 21, NOUN 43 flashing

00003 ENTR

Observe VERB 21, NOUN 42 flashing

6.3.15.11.12 Set the AOT in the R detent position.

6.3.15.11.13 Rotate the AOT control knob clockwise until the center of the R target reticle is superimposed between the double Y reticle. Record the AOT dial indication as RY = XXX, XX.

6.3.15.11.14 Rotate the AOT control knob until the center of the R target reticle is superimposed between the double SPIRAL reticle lines. Record the AOT dial indication as RS = XXX, XX.

6.3.15.11.15 On the DSKY enter:

±XXX,XX ENTR (R Y from 6.3.15.11.13)

Observe VERB 22 NOUN 42 flashing

±XXX,XX ENTR (R S from 6.3.15.11.14)

Observe VERB 06 NOUN 03 displayed. Record R1, the angle should be zero (0) ± 0.08 degree.

APPENDIX I

MEASUREMENT TOLERANCES

<u>SIGNAL</u>	<u>SIGNAL NAME</u>	<u>G&N LAB TEST REQUIREMENT</u>	<u>PSAAM AND/OR SCA UNCERTAINTY 1% OF FULL SCALE</u>
GG 1090 link 4*	+14 vdc LGC Supply	14.0±0.4 vdc	0%
GG 1030 link 4	+4 vdc LGC Supply	4.0±0.2 vdc	0%
GG 1040 link 5**	+120 vdc PIPA Supply	120±6.0 vdc	1%
GG 1070 link 4	+4 vdc CDU Supply	4.0±0.2 vdc	0%
GG 1100 link 4	-28 vdc Supply	-27.5±6.0 vdc	0%
GG 1110 link 5	2.5 vdc Telemetry Bias No. 1	2.5±0.06 vdc	0%
GG 1201 link 5	IMU 28V 800 cps 1%	28±0.56V rms	1%
GG 1202 link 4	IMU 28V 800 cps 5%	28±1.4V rms	1.5%
GG 1203 link 4	IMU 28V 800 cps 5%	28±2.1V rms	1.5%
GG 1331 link 5	3.2 kc 28V Supply 1%	28.6±0.56V rms	1%
GG 1500 link 4	+28 vdc IMU Oper BUS	28.0 -3.5, +5.5 vdc	0%
GG 1510 link 4	+28 vdc IMU STBY BUS	28.0 -6.0, +5.5 vdc ⊕	0% IMU STBY }
GG 1513X link 5	+28 vdc IMU STBY/OFF	28.0±1 vdc	0% ON only }
GG 1520 link 4	+28 vdc LGC Oper BUS	28.0 ±4.5 vdc, ±1 vdc	0%
GG 1523X link 5	+28 vdc LGC Operate	28.0±1 vdc	0%
GG 2001 link 5	X PIPA S.G. OUT IN PH	+2.5±0.128V rms at 1g	3%
GG 2021 link 5	Y PIPA S.G. OUT IN PH	+2.5±0.128V rms at 1g	3%
GG 2041 link 5	Z PIPA S.G. OUT IN PH	+2.5±0.128V rms at 1g	3%
GG 2106 link 4	IG Servo Error Total	0.0±60 MV rms at null	1%
GG 2107 link 5	IG Servo Error IN PH	0.0±60 MV rms at null	2%
GG 2110 link 4	IG Torque Motor Current	0.5 AMP Max during any fine Align Torque	0%
GG 2110 link 5	IG Torque Motor Current	0.5 AMP Max during any fine Align Torque	1%
GG 2112 link 5	IG 1X Resolver Out-Sine	18.4±1.84V rms at 45°	2.5%
GG 2113 link 5	IG 1X Resolver Out-Cosine	18.4±1.84V rms at 45°	2.5%
GG 2121 link 5	IG 1X Resolver Out-Sine 11°	5.35±0.27V rms at 11°	2%
GG 2136 link 4	MG Servo Error Total	0.0±60 MV rms at null	1%
GG 2137 link 5	MG Servo Error IN PH	0.0±60 MV rms at null	2%
GG 2140 link 4	MG Torque Motor Current	0.5 AMP Max during any fine Align Torque	0%
GG 2140 link 5	MG Torque Motor Current	0.5 AMP Max during any fine Align Torque	1%
GG 2142 link 5	MG 1X Resolver Out-Sine	18.4±1.84V rms at 45°	2.5%
GG 2143 link 5	MG 1X Resolver Out-Cosine	18.4±1.84V rms at 45°	2.5%
GG 2151 link 5	MG 1X Resolver Out-Sine 11°	5.35±0.27V rms at 11°	2%
GG 2166 link 4	OG Servo Error Total	0.0±60 MV rms at null	1%
GG 2167 link 5	OG Servo Error IN PH	0.0±60 MV rms at null	2%
GG 2170 link 4	OG Torque Motor Current	0.9 AMP Max during any fine Align Torque	0%
NG 1336 link 4	PH DIFF 3.2kc	0° ±10°	3%
GG1510 Link 4	28V/LGC SYNC +28 VDC IMU STBY BUS IMU STBY ON-IMU OPER ON	28.0 -4.5, +4.5 vdc	0%

APPENDIX I (Continued)

<u>SIGNAL</u>	<u>SIGNAL NAME</u>	<u>G&N LAB TEST REQUIREMENT</u>	<u>PSAAM AND/OR SCA UNCERTAINTY % OF FULL SCALE</u>
GG 2170 link 5	OG Torque Motor Current	0.9 AMP Max during any fine Align Torque	1%
GG 2172 link 5	OG 1X Resolver Out-Sine	18.4±1.84V rms at 45°	2.5%
GG 2173 link 5	OG 1X Resolver Out-Cosine	18.4±1.84V rms at 45°	2.5%
GG 2181 link 5	OG 1X Resolver Out-Sine 11°	5.35±0.27V rms at 11°	2%
GG 2219 link 5	Pitch Attitude Error	5.05±0.5V rms at 17°	1%
GG 2220 link 4	IG CDU Fine Error	0.0±0.07V rms at null	1%
GG 2221 link 4	IG CDU Coarse Error	0.0±0.68V rms at null	1%
GG 2249 link 5	YAW Attitude Error	5.05±0.5V rms at 17°	1%
GG 2250 link 4	MG CDU Fine Error	0.0±0.07V rms at null	1%
GG 2251 link 4	MG CDU Coarse Error	0.0±0.68V rms at null	1%
GG 2279 link 5	Roll Attitude Error	5.05±0.5V rms at 17°	1%
GG 2280 link 4	OG CDU Fine Error	0.0±0.07V rms at null	1%
GG 2281 link 4	OG CDU Coarse Error	0.0±0.68V rms at null	1%
GG 2300 link 5	PIPA Temperature	130.5±1.5°F in Operate	1%
GG 2301 link 4	IRIG Temperature	135±2.5°F in Operate	1%
GG 2301 link 5	IRIG Temperature	135±2.5°F in Operate	1%
GG 2302 link 4	IMU Heater Current On	28±1 vdc	0%
GG 2303 link 4	IMU Blower Current On	28±1 vdc	0%
GG 3304 link 5	RR Shaft 1X Resolver Out-Sine	19.65±0.98V rms at 45°	2.5%
GG 3305 link 5	RR Shaft 1X Resolver Out-Cosine	19.65±0.98V rms at 45°	2.5%
GG 3311 link 4	RR Shaft CDU Fine Error	0.0±0.07V rms at null	1%
GG 3312 link 4	RR Shaft CDU Coarse Error	0.0±0.68V rms at null	1%
GG 3321 link 4	RR Trunnion CDU Fine Error	0.0±0.07V rms at null	1%
GG 3322 link 4	RR Trunnion CDU Coarse Error	0.0±0.68V rms at null	1%
GG 3324 link 5	RR Trunnion 1X Resolver Out-Sine	19.65±0.98V rms at 45°	2.5%
GG 3325 link 5	RR Trunnion 1X Resolver Out-Cosine	19.65±0.98V rms at 45°	2.5%
GG 4300 link 4	LGC Temperature	87.5±42.5°F	0%
GG 6020 link 4	PIPA Calibration Module Temperature	67.5±22.5°F	0%
GG 6020 link 5	PIPA Calibration Module Temperature	67.5±22.5°F	0%
GG 6021 link 4	PSA Temperature	85±25.0°F	0%

<u>SIGNAL</u>	<u>SIGNAL NAME</u>	<u>G&N LAB TEST REQUIREMENT</u>	<u>PSAAM AND/OR SCA UNCERTAINTY OF FULL SCALE</u>
NG1021 link 4	14 VDC LGC Noise RMS	0.4 VRMS Max	0%
NG1022 link 4	14 VDC LGC Noise Peak	5 volts with rise time of 2 to 5 usec	0%
NG1031 link 4	4 VDC LGC Noise RMS	0.4 VRMS Max	0%
NG1032 link 4	4 VDC LGC Noise Peak	5 volts with rise time of 2 to 50 used	0%
NG1071 link 4	4 VDC CDU Noise RMS	1.0 VRMS Max	0%
NG1072 link 4	4 VDC CDU Noise Peak	5 volts with rise time of 2 to 50 usec	0%
NG1501 link 4	28 VDC IMU Operate Noise RMS	1.0 VRMS Max	0%
NG1502 link 4	28 VDC IMU Operate Noise Peak	5 volts with rise time of 2 to 50 usec	0%
NG1511 link 4	28 VDC IMU Standby Noise RMS	1.0 VRMS Max	0%
NG1512 link 4	28 VDC IMU Standby Noise Peak	5 volts with rise time of 2 to 50 usec	0%
NG1521 link 4	28 VDC LGC Operate Noise RMS	1.0 VRMS Max	0%
NG1522 link 4	28 VDC LGC Operate Noise Peak	5 volts with rise time of 2 to 50 usec	0%

*Link 4 - PSAAM Output Signal

**Link 5 - SCA Output Signal

ADDENDUM V

Following are the changes required to make this document applicable for use with the Restart Monitor Blackbox P/N 2898989.

Addition 1: Add paragraphs as follows:

5.11.2 If a LGC RESTART occurs the following entries should be made on DSKY or K-148:

VERB 01 NOUN 10 ENTR
00077 ENTR

Record the contents of DSKY Row 1.

VERB 21 NOUN 10 ENTR
00077 ENTR
00000 ENTR

5.11.2.1 The contents of Row 1 should be interpreted as follows:

Alarm Source	Channel 77 Code (Octal)
*** Parity Fail (F Memory)	001
** Parity Fail (E Memory)	003
** TC Trap	004
** Rupt Lock	010
** Nightwatchman	020
*** Voltage Fail	040
Counter Fail	100
Scaler Fail	200
Scaler Double Frequency Alarm	400

* Note: Parity Fail will either be in E or F Memory, but not in combination.

** There is a possibility that a Counter Fail Alarm will also occur, depending on when the alarm occurs, in which case bit 7 will be set also.

*** Other alarms will probably occur before the Voltage Fail Alarm occurs, in which case the contents of Channel 77 will contain the octal sum of all the alarms, but it will contain the Voltage Fail Code.

Addition 2: Add Paragraph 6.2.4.5 as follows:

6.2.4.5 On K-148 enter the following sequence:

VERB 21	NOUN 10	ENTR
00077		ENTR
00000		ENTR

Addition 3: Add paragraph 6.3.1.5.1.1 as follows:

6.3.1.5.1.1 On K-148 enter the following sequence:

VERB 21	NOUN 10	ENTR
00077		ENTR
00000		ENTR

Addition 4: Add Paragraph 6.3.1.6.6.7 as follows:

6.3.1.6.6.7 On K-148 enter the following sequence:

VERB 21	NOUN 10	ENTR
00077		ENTR
00000		ENTR

Addition 5: Add Paragraph 6.3.2.1.4.1 as follows:

6.3.2.1.4.1 On K-148 enter the following sequence:

VERB 01	NOUN 10	ENTR
00077		ENTR

Verify DSKY Row 1 displays 00001 or 00101.

VERB 21	NOUN 10	ENTR
00077		ENTR
00000		ENTR

Addition 9: Add Paragraph 6.3.2.3.5.1 as follows:

6.3.2.3.5.1 On K-148 enter the following sequence:

VERB 01	NOUN 10	ENTR
00077		ENTR

Verify DSKY Row 1 displays 00004 or 00104.

VERB 21	NOUN 10	ENTR
00077		ENTR
00000		ENTR

Addition 10: Add Paragraph 6.3.2.4.2.1 as follows:

6.3.2.4.2.1 On K-148 enter the following sequence:

VERB 01	NOUN 10	ENTR
00077		ENTR

Verify DSKY Row 1 displays 00020 or 00120.

VERB 21	NOUN 10	ENTR
00077		ENTR
00000		ENTR

Addition 11: Add Paragraph 6.3.10.2.6.1 as follows:

6.3.10.2.6.1 On K-148 enter the following sequence:

VERB 01	NOUN 10	ENTR
00077		ENTR

Verify DSKY Row 1 display has bit 6 on. Other combinations of bits are permissible but bit 6 must be on.

Addition 12: Revise Paragraph 6.3.10.2.7 to read as follows:

6.3.10.2.7 On PSAAM, set INHIBIT VOLTAGE FAIL switch ON.
On DSKY enter the following:

VERB 21	NOUN 10	ENTR
00077		ENTR
00000		ENTR
Press		RSET

Verify RESTART light is OFF.

Addition 13: Add Paragraph 6.3.10.2.9.1 as follows:

6.3.10.2.9.1 On K-148 enter the following sequence:

VERB 01	NOUN 10	ENTR
00077		ENTR

Verify DSKY Row 1 display has bit 6 on. Other combinations of bits are permissible but bit 6 must be on.

Addition 14: Revise Paragraph 6.3.10.2.10 to read as follows:

6.3.10.2.10 On PSAAM, set INHIBIT VOLTAGE FAIL switch ON.
On DSKY enter the following:

VERB 21	NOUN 10	ENTR
00077		ENTR
00000		ENTR
Press		RSET

Verify that RESTART light is OFF.

Addition 15: Add Paragraph 6.3.10.2.14.1 as follows:

6.3.10.2.14.1 On K-148 enter the following sequence:

VERB 01	NOUN 10	ENTR
00077		ENTR

Verify DSKY Row 1 display has bit 6 on. Other combinations of bits are permissible but bit 6 must be on.

Addition 16:

Revise Paragraph 6.3.10.2.15 to read as follows:

6.3.10.2.15

On PSAAM, set INHIBIT VOLTAGE FAIL switch ON.
On DSKY enter the following:

VERB 21	NOUN 10	ENTR
00077		ENTR
00000		ENTR
Press		RSET

Verify that RESTART light is OFF.

Addition 17:

Add Paragraph 6.3.10.2.17.1 as follows:

6.3.10.2.17.1

On K-148 enter the following sequence:

VERB 01	NOUN 10	ENTR
00077		ENTR

Verify DSKY Row 1 display has bit 6 on. Other combinations of bits are permissible but bit 6 must be on.

Addition 18:

Revise Paragraph 6.3.10.2.18 to read as follows:

6.3.10.2.18

On PSAAM, set INHIBIT VOLTAGE FAIL switch ON.
On DSKY enter the following:

VERB 21	NOUN 10	ENTR
00077		ENTR
00000		ENTR
Press		RSET

Verify that RESTART light is OFF.

Addition 19:

Add Paragraph 6.3.11.16.1 as follows:

6.3.11.16.1

On K-148 enter the following sequence if the RESTART lamp came on in above step.

VERB 21	NOUN 10	ENTR
00077		ENTR
00000		ENTR
Press		RSET

APOLLO G&N Specification
 ND1002323 REV R
 Original Issue Date:
 Release Authority: TDRR
 Class A Release

POST-INSTALLATION CHECKOUT SPECIFICATION
 FOR LM G&N SYSTEM

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
11/27/68	L	37063	7, 24, 35, 60, 76, 81 Total No. pages now 106. <i>HA/AC</i>	EA	WLS
3/27/69	M	37452	14, 20-22, 43-105, Was 105 pages, now 109 pages. <i>HA/AC</i>	EA	RJj
6/18/69	N	37620	20-68 <i>HA/AC</i>	EA	--
11/6/69	P	37912	54 - 109. Was 109 pages; now 114. <i>HA/AC</i>	EA	MDH
11/25/69	R	37984	26 <i>HA/AC</i>	EA	MDH

This specification consists of page 1 to 114 inclusive.

APPROVALS	W.S. Swingle NASA/MSC	MIT/IL	R.D. Petryk D.A. Ziemer AC	J.F. Pizzala 9/23/66
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APOLLO G&N Specification
 ND1002323 REV 8
 Original Issue Date:
 Release Authority: TDRR
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POST-INSTALLATION CHECKOUT SPECIFICATION
 FOR LM G&N SYSTEM

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Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
11/27/68	L	37063	7, 24, 35, 60, 76, 81 Total No. pages now 106. <i>W.H./AC</i>	EA	WLS
12/27/69	M	37452	14, 20-22, 43-105, Was 105 pages, now 109 pages. <i>W.H./AC</i>	EA	RJJ
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11/6/69	P	37912	54 - 109. Was 109 pages; now 114. <i>W.H./AC</i>	EA	MDH
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3/13/70	S	38077	14, 23, 24, 29, 31, 94-96, 109, 110. <i>W.H./AC</i>	EA	MDH

This specification consists of page 1 to 114 inclusive.

APPROVALS	W. S. Swingle			R. D. Petryk	
	NASA/MSC		MIT/IL	D. A. Ziemer	J. F. Pizzala AC 9/23/66

APOLLO G&N Specification
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POST-INSTALLATION CHECKOUT PROCESS SPECIFICATION
 FOR THE APOLLO GUIDANCE & NAVIGATION SYSTEM (SPACECRAFT 14, KSC)

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				MIT	NASA
10/12/66	A	31495	1-123 Was 123 pages, now 124 pages. <i>gsl/jar</i>	EA	--

This specification consists of page 1 to 124 inclusive.

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4.1 (Continued)

<u>Item</u>	<u>Quantity</u>	<u>Description</u>
16	1	Inertial Components Temperature Controller (ICTC) Model No. 823-100
17	1	PBA Adapter Module, Model No. A23-201
18	1	Volt Ohmmeter Simpson, Model No. 269 or equivalent.
19	1	Calculator (Friden or equivalent)
20	1	E-Memory Zeroing Tape No. F04C014-KD0012-00
21	1	Stopwatch
22	1	G&N Polarity Test (System Level Only) F04C014-KD0019-00
23	1	Shorting Plug No. 45A7P2
24	1	Electrical Cable Portable G&N System, Model No. A23-097 C14-462
25	1	Optics Supporting Fixture, Model No. A14-135
26	1	G&N Installation Qualification Fixture, Model No. A23-097
27	1	SCT Resolution Check Card
28	1	DKM-3 Theodolite
29	1	Retroreflecting Prism 1019840, Model No. A23-200
30	1	Movable Optics Target
31	1	Portable Light Assembly (Light Scanning Telescope)
32	1	Electronic Counter with Preset Counter (Hewlett-Packard 5245L with 5264A Preset or equivalent)
33	1	Extender Cable Set
34	1	Flexible Driver TM-62A

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4.1 (Continued)

<u>Item</u>	<u>Quantity</u>	<u>Description</u>
35	1	Hex Head Cap Screwdriver TM AL-5 (5/32 Hex) (or equivalent)
36	1	Carry-on Cable Set C14-574
37	1	AOC Alarms and Interrupts Test Tape, No. FO4C014-KD0020-00
38	1	Gimbal Friction Test Tape No. FO4C014-KD0031-00

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5.2 Standard Environmental Conditions

- 5.2.1 The G&N System shall be tested under clean room class 100,000 conditions as specified in process specification MA0610-018A, Contamination Control - Apollo Command Module and Service Module, while installed and operating in the command module.
- 5.2.1.1 For periods of G&N testing with the optical heads and the eyepieces of the SXT and SCT of the C/M G&N uncovered, or with the eyepieces removed, the environment shall meet at least the Class 100,000 specifications for the particle size and count. (No more than 100,000 particles 0.5 microns or larger per cubic foot with no more than 700 particles 5.0 microns or larger per cubic foot). Dust covers shall be installed on the SXT and SCT per ICD MH01-01250-116 when optics are not under test.
- 5.2.2 The Apollo G&N System shall interface with a qualified ECS distribution system which shall supply coolant fluid during STANDBY and OPERATE control modes with flow rates and inlet temperatures as specified in ICD MH01-01249-416.

5.3 Test Equipment Tolerances

- 5.3.1 All tolerances specified herein do not include instrumentation uncertainties.

5.4 Test Sequence

- 5.4.1 The Test Sequence normally should follow the steps outlined by Code numbers in Figure I in the order specified. This normal order can be deviated on approval by the G&N Installation Unit, Department 697-506.
- 5.5 After the defective, replaceable element has been substituted with a flight certified unit, the G&N System checkout sequence shall regress to the rerunning of applicable portions of the selected sequence (by paragraph number) categorized by the subassembly in which the malfunction occurred. The chosen subassembly categories are presented in Table II versus an appropriate retest paragraph sequence. Retest shall be conducted by performing applicable portions of all indicated paragraph numbers in the sequence listed as indicated under the appropriate subassembly heading. Retest shall proceed to the point in the normal test sequence at which the discrepancy was detected and corrected. Normal testing shall continue beyond this point in the specified sequence of Table I.
- 5.6 It is assumed that the Test Conductor has a working knowledge of the test equipment used; therefore, this procedure contains only the steps related directly to the G&N System components. If any questions arise concerning the test equipment, the Conductor should refer to the pertinent operational manuals.

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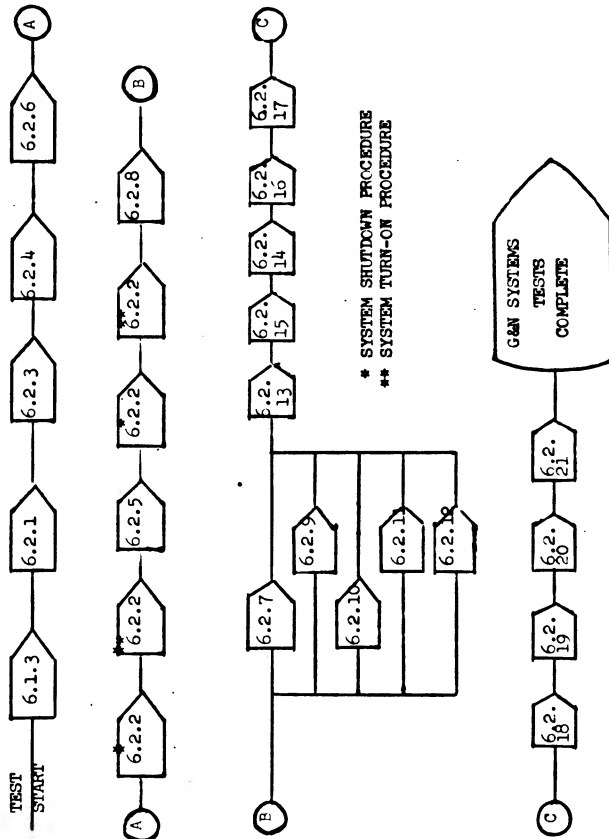


FIGURE 1

G&N INDIVIDUAL SYSTEMS TEST SEQUENCE

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TABLE I.
TEST SEQUENCE

PARAGRAPH NO.	TEST TITLE
6.1.3	Pre-Power Application Tests (Part of G&N Installation OCP)
6.2.1	Application of Standby Power to G&N System
6.2.2	Turn On and Shutdown Procedure
6.2.3	AGC Operational Test
6.2.4	Operate Power On and Power Supply Test
6.2.5	Failure Indicating Circuitry Test
6.2.6	G&N Operational Test
6.2.7	IMU Temperature Control Test
6.2.8	AGC Clock Frequency Test
6.2.9	G&N Panel Brightness and Lamp Test
6.2.10	Zero Optics Test
6.2.11	Optics Slew Rate Test
6.2.12	Optics Coordinate Transformation Control Test
6.2.13	Optics Positional Accuracy Test
6.2.15	Gimbal Friction Test
6.2.14	AGC Mode Control Test
6.2.16	Stabilization Loop Step Response Test
6.2.17	IRIG Scale Factor Test
6.2.18	PIPA Scale Factor Determination Test
6.2.19	IRIG Coefficient Determination Test
6.2.20	Fine Alignment Test SXT-MB-IMU
6.2.21	Gyro Compassing Test

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TABLE II. RETEST SEQUENCE

Paragraph Number	IMU	OPTICS	AOC	PSA TRAY 1	PSA TRAY 2	PSA TRAY 3	PSA TRAY 4	PSA TRAY 5	PSA TRAY 6	PSA TRAY 7	PSA TRAY 8	PSA TRAY 9	PSA TRAY 10	G&N DSKY	AOC DSKY	DAC ELEC	SIG COMD	CCDU'S	ICDU'S	G&N HARNESS
6.1.3	X	X																	X	
6.2.1	X		X X X					X											X	
6.2.2		X										X X								
6.2.4	X X X	X X X X X X X X X X X X X X X X X																		
6.2.5				X				X										X		
6.2.3		X		X X								X X							X	
6.2.9		X											X X X							
6.2.7	X	X X						X							X					
6.2.10		X X								X X X						X X				
6.2.11		X								X X X							X			
6.2.12		X								X X X							X			
6.2.13		X								X X X							X		X X	
6.2.14	X		X X X X X X X X X													X				
6.2.15	X		X X X X X X X X X											X X X				X X		
6.2.16	X		X X X					X												
6.2.17	X		X X X X X					X X												
6.2.18	X		X X X X X					X X												
6.2.19	X		X X X X X					X X											X	
6.2.20	X		X X X X X					X X												
6.2.21	X X X X X X X							X X							X X					
6.2.8		X																		

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- 5.10 The procedure accomplished and the requirements listed herein are verified through the use of Acceptance Checkout Equipment - Spacecraft (ACE-S/C). The Ground Support Equipment (GSE) shall be augmented by the following list of signal conditioning carry-on equipment. This equipment must be connected and ready for operation before the test of this specification is initiated.
- a. Carry-on PCM System, Model No. C14-210
 - b. Digital Signal Conditioner and Multiplexing Unit, Model No. C14-211
 - c. G&N Signal Conditioner and Switching Matrix, Model No. C14-213
 - d. Carry-on Receiver and Baseplate, Model No. C14-200
 - e. Carry-on Baseplate Unit, Model No. C14-201
 - f. Junction Box ACE-S/C Carry-on, Model No. C14-202
 - g. Carry-on ACE-S/C Response System Support Rack, Model No. C14-203
 - h. Support Frame Carry-on DTCS, Model No. C14-204
- 5.10.1 Ground Support Equipment (GSE) carry-on gear in support of the signal conditioning carry-on gear shall consist of the following:
- a. Electrical Cable Set, Model No. C14-178
 - b. PSA Test Point Adapter, Model No. A23-167
 - c. Breakout Box - Test C/M-S/M Adapter, Model No. C14-467
 - d. Volt Ohmmeter Simpson Model No. 269 or equivalent
- 5.10.2 Ground Support Equipment (GSE) required for performing other selected G&N tests consists of the following:
- a. Volt Ohmmeter, Simpson Model No. 269 or equivalent
 - b. Optics Support Fixture, Model No. A14-135
 - c. G&N Installation Qualification Fixture, Model No. A23-071
 - d. Azimuth Reference Fixture, Model No. A23-096
 - e. Theodolite (JBM3 or equiv.) Model No. A23-079
 - f. Retroreflecting Prism 1019840 Model No. A23-200
 - g. Portable Light Assembly (SCT lamp)

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5.10.3 Miscellaneous hardware required in support of G&N testing consists of the following:

a. Movable Optics Target

5.11 Data Record

5.11.1 All data concerning the checkout and operation of the G&N System as monitored via ACE, shall be recorded on the data sheets associated with their corresponding test. Out-of-tolerance readings shall be recorded and flagged by appropriate symbols to attention.

5.11.1.1 Test Data. All test data obtained while demonstrating the requirements of this document shall permanently be recorded and forwarded with the tested G&N to the next receiving agency.

5.11.1.2 An authorized Quality Control Representative shall monitor this test and verify compliance to this specification by signing or stamping applicable documents including all test data recorded. (Form 962-T or equivalent).

5.11.2 The PCM Raw Data magnetic tape recorder shall be turned on at all times while any portion of the G&N is operating.

5.11.3 The Event Recorder, 4A2-A2, shall be turned on at all times while any portion of the G&N System is operating.

5.12 Interface

5.12.1 The APOLLO G&N System shall interface with accepted ECS and EPS distribution systems for power and environment control purposes and with the SCS or SC8 substitute system for signal interface according to the ICD's listed below.

- | | |
|-----------------------|---|
| a. ICM MH01-01220-216 | Interconn Diagram-AGC to AGC DSKY
(Main Display Panel) |
| b. ICD MH01-01224-416 | Attitude Error Signals |
| c. ICD MH01-01225-416 | Total Attitude Signal |
| d. ICD MH01-01226-200 | Central Timing Equipment Sync. Pulse |
| e. ICD MH01-01227-216 | G&N-Electrical Input Power |
| f. ICD MH01-01228-416 | G&N Data Transmission to Operational
PCM-Telemetry Equipment |
| g. ICD MH01-01236-200 | ACE Uplink, SC Digital Up-Data Link AGC |
| h. ICD MH01-01237-216 | G&N-Hold Attitude |
| i. ICD MH01-01242-416 | G&N Condition & Display Lights |
| j. ICD MH01-01249-416 | G&N-Thermal Requirements |

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5.13 Optics Power Turn on Procedure for Optical GSE Alignment Test

5.13.1 The Optical GSE Subsystem Alignment Test must be completed before proceeding with the following tests:

- a. 6.2.13 Optic Positional Accuracy Test
- b. 6.2.20 Fine Alignment Test
- c. 6.2.21 Gyro Compassing Test
- d. 6.2.18 PIPA Scale Factor Determination Test

5.13.2 The G&N Optics Turn On procedure for Optical GSE Subsystem Alignment Test may be performed at anytime in the test sequence specified in Figure 1 after the performance of 6.2.4. Optics power shall only be applied during those tests requiring use of the Optics or measurement of Optics parameters.

5.13.3 G&N Optics Power Turn-On

5.13.3.1 Insure that the SXT and SCT eyepieces are installed properly on the G&N optics base. The optics switches and selectors on the G&N Indicator Control Panel shall be set to the following positions:

- a. SLAVE TELESCOPE to STAR LOS
- b. OPTICS MODE to ZERO OPTICS
- c. CONTROLLER MODE to DIRECT
- d. CONTROLLER SPEED to LO
- e. POWER and BRIGHTNESS to ON
- f. PANEL BRIGHTNESS to MAXIMUM INCREASE

5.13.3.2 Place or verify that the VIEWER AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON position. (Breakers pushed in).

5.13.3.3 Place the OPTICS MNA and MNB breakers on the Right Hand Circuit Breaker Panel to ON position. (Breakers pushed in).

5.13.3.4 Verify that the ZERO ENCODER on the Condition Annunciator Panel is lighted for no more than 90 seconds after optics power turn on.

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- 5.13.3.5 OPTICS +28 VDC DISCRETE shall be issued (CG1533) by observing that the OPTICS lamp on the Event Module is lighted.
- 5.13.3.6 Sight through the SIX eyepiece to verify that the optical reticles are illuminated.
- 5.13.3.7 Verify that the optics supply voltage listed below appear on the CRT:
- a. CG 1401 OPTX 2V 25.6 KC Supply in PH +2.1 to 2.9 VRMS
 - b. CG 1211 OPTX 28V .8 KC 1 $\frac{1}{2}$ DEG supply +27 to 29 VRMS
 - c. CG 1212 OPTX 28V .8 KC 5 $\frac{1}{2}$ -90 supply +26.1 to 29.9 VRMS
- 5.13.3.8 Verify the 2X TRUNNION and SHAFT Angles on the CDU panel display 000.000 \pm 0.100 degrees.
- 5.13.3.9 Ensure that the optics GSE, Optics Support Fixture, Model No. A14-135, has been properly installed.
- 5.13.3.10 Proceed with the Optical GSE Subsystem Alignment Test in accordance with MAC201-5036.
- 5.14 There are requirements in 6.2.7 IMU Temperature Control Test, 6.2.18 PIPA Scale Factor Determination Test, and 6.2.19 IRIG Coefficient Determination Test that must be obtained from the Acceptance Data Package. The aforementioned data, which fulfilled the requirements, shall be available prior to checkout of the G&N System.

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6. DETAIL REQUIREMENTS

6.1 Initial Test Conditions

- 6.1.1 The following precautions shall be observed to preclude loss of continuity in inertial component performance history of the IMU. Deviation may necessitate recalibration of the inertial components.
- 6.1.1.1 The IMU shall be supplied with heater power on a continuous basis unless otherwise specified. When S/C Ground Power Supply, Model No. C14-418 is not providing heater power, then heater power shall be supplied through the Inertial Components Temperature Controller (ICTC) Model No. S23-100. The temperature of the inertial components shall not drop below 120°F while under control of the ICTC.
- 6.1.1.2 The Standby Mode is identified by the circuit breakers IMU HTR MN A, IMU HTR MN B, COMPUTER MN A and COMPUTER MN B in the ON position and IMU MN A and MN B in the OFF position. The Operate Mode is identified by the circuit breaker IMU HTR MN A, IMU HTR MN B, COMPUTER MN A, COMPUTER MN B, the Computer Mode Control (CMC) switch to the ON position, and IMU MN A and IMU MN B in the ON position. The G&N System shall be operating in the Standby Mode (with CMC power ON) for a minimum of two hours prior to advancing to the IMU Operate Mode. In the event Standby Mode power is interrupted, an equivalent time period shall be allowed when power is restored before advancing to the Operate Mode, except that when the interval of interruption exceeds two hours, a two-hour warm-up period shall be mandatory.
- 6.1.1.2.1 After 6.2.4.6.3 and 6.2.2.1 have been performed and it is known that the spacecraft or IMU have not been moved, and that the shutdown period did not exceed 5 days, it is permissible to enter the IMU Operate Mode after the system has been in the Standby mode for a minimum of 90 seconds.
- 6.1.1.3 The Inertial Measurement Unit shall not be without Heater power for a period greater than 15 minutes.
- 6.1.1.4 During the turn on the G&N power, the COMPUTER MN A, COMPUTER MN B, IMU HTR MN A and IMU HTR MN B circuit breakers must be turned on before the IMU MN A and IMU MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. During the turn off of the G&N power, the IMU MN A and IMU B circuit breakers must be turned off before the IMU HTR MN A and IMU HTR MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM.

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- 6.1.1.5 A warm-up period of one hour with OPERATE power applied shall be required prior to performing any test in which gyro or accelerometer parameters are measured, and a 15 minute warm-up period to any test in which precision amplitude and frequency power supply checks are made.
- 6.1.1.6 The AGC Mode switch shall never be in the STANDBY position when Operate Power is supplied to the G&N System.
- 6.1.1.7 Remove Operate power if any of the following situations occur as indicated by observing the gimbal resolvers total attitude signals displayed on ACE meters. (CG2112 IGA 1X RES OUTPUT SINE IN PHASE, CG 2113 IGA 1X RES OUTPUT COS IN PHASE, CG 2142 MGA 1X RES OUTPUT SINE IN PHASE 2143 MGA 1X RES OUTPUT COS IN PHASE, CG 2172 OGA 1X RES OUTPUT SINE IN PHASE, and CG 2173 OGA 1X RES OUTPUT COS IN PHASE.
- a. The gimbals do not stop moving within 15 seconds after first applying operate power while in coarse align.
 - b. The gimbals do not stop moving within 5-6 seconds after the IMU delay light goes out or when changing from coarse align to fine align attitude control or entry.
 - c. The gimbals do not stop moving with 5-6 seconds after inserting or removing the step Response Test input.
- 6.1.2 The UPTL switch on the MDC AGC DSKY Panel No. 14 shall remain in the ACCEPT Position except when otherwise specified as procedural function.
- 6.1.2.1 In no case shall the MARK REJECT button be pressed on the G&N Indicator Control Panel.

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TABLE III. RESISTANCE REQUIREMENTS OF SC/G&N POWER

Test Number	Ground	From	To	Requirements	
1	OVDC IMU	56P11-D	56P11-L	5.0 mega	to infinity
2	OVDC IMU	56P11-D	56P11-G	1000.0 ohms	to infinity
3	OVDC IMU	56P11-D	56P11-J	1000.0 ohms	to infinity
4	OVDC IMU	56P11-D	56P11-K	5.0 mega	to infinity
5	OVDC IMU	56P11-D	56P11-E	0.0 ohms	to 0.5 ohms
6	OVDC IMU	56P11-D	56P11-F	0.0 ohms	to 0.5 ohms
7	OVDC IMU	56P11-D	56P12-D	0.0 ohms	to 0.5 ohms
8	OVDC Optics	56P11-G	56P12-G	0.0 ohms	to 0.5 ohms
9	OVDC AGC	56P11-J	56P12-J	0.0 ohms	to 0.5 ohms
10	Structure Grd	56P11-L	56P12-L	0.0 ohms	to 0.5 ohms
11	OVDC IMU	56P11-E	56P12-F	0.0 ohms	to 0.5 ohms
12	OVDC IMU	56P11-F	56P12-F	0.0 ohms	to 0.5 ohms
13	OVDC Optics	56P11-G	56P11-L	5.0 mega	to infinity
14	OVDC AGC	56P11-J	56P11-G	5.0 mega	to infinity
15	OVDC AGC	56P11-J	56P11-L	5.0 mega	to infinity
16	400-115V	56P11-K	56P11-L	5.0 mega	to infinity
17	400-115V	56P11-K	56P11-G	5.0 mega	to infinity
18	500-115V	56P11-K	56P11-J	5.0 mega	to infinity

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6.1.3 Pre-Power Application Requirements

CAUTION

Ensure that the power connection from the Inertial Component Temperature Controller or PTC is connected and remains connected to PSA TRAI 7 front panel connector, 45A7J2.

- 6.1.3.1 Prior to connecting G&N power connector 56P11 and 56P12 to spacecraft power connectors C27-1A16-J190 and C27-1A16-J191 respectively, it is necessary to perform a complete verification of spacecraft power.
- 6.1.3.2 Ensure that G&N connectors 56P9, 05A3J2 and 45A1J1 through 45A10J1 are disconnected from their mating connectors.
- 6.1.3.3 Ensure that the circuit breakers as listed in Table V on the S/C Right Hand Circuit Breaker Panel are in the OPEN position. (Breakers pulled out.)
- 6.1.3.4 Obtain Extender Cable Set and insert connectors to G&N Connector 56P11 and 56P12, located at the lower rear portion of the Right Hand Support Panel.
- 6.1.3.5 Using a volt ohmmeter (4.1, Item 18), the resistance between the pins shall be as follows in Tables III and IV.

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TABLE IV. RESISTANCE REQUIREMENTS ON G&N POWER CONNECTORS

Test Number	From	To	Requirements	Test Results
1	56P11-A	56P11-J	2.4 ohms to infinity	
2	56P11-B	56P11-D	2.4 ohms to infinity	
3	56P11-C	56P11-D	2.4 ohms to infinity	
4	56P11-H	56P11-G	7.7 ohms to infinity	
5	56P11-M	56P11-D	11.8 ohms to infinity	
6	56P11-N	56P11-K	2.0 ohms to infinity	
7	56P12-A	56P12-J	2.4 ohms to infinity	
8	56P12-B	56P12-D	2.4 ohms to infinity	
9	56P12-C	56P12-D	2.4 ohms to infinity	
10	56P12-H	56P12-G	7.7 ohms to infinity	
11	56P12-M	56P12-D	11.8 ohms to infinity	

- 6.1.3.6 Disconnect connector 56P11 and 56P12 from the Extender Cable Set connector.
- 6.1.3.7 Insert connectors of Extender Cable set spacecraft power connectors C27-1A16-J190 and C27-1A16-J191.
- 6.1.3.8 Polarity and Voltage Check on SC/G&N Power
- 6.1.3.8.1 The following circuit breakers on the Right Hand Circuit Breaker Panel, as listed in Table V, shall be closed (breakers pushed in) and the voltage across the pins at specified SC connectors shall be within its requirements.

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TABLE V. POLARITY AND VOLTAGE REQUIREMENTS ON SC/G&N POWER

Test Number	Subsystem Circuit Breakers	Polarity and Connector Pin No.		Requirements
		Low	High	
1	COMPUTER MN A	C27-1A16J-190-J	C27-1A16J-190-A	+27.3 \pm 2.5 VDC
2	OPTICS MN A	C27-1A16J-190-G	C27-1A16J-190-H	+27.3 \pm 2.5 VDC
3	IMU MN A	C27-1A16J-190-D, E, F	C27-1A16J-190-B, C	+27.3 \pm 2.5 VDC
4	IMU HTR MN A	C27-1A16J-190-F	C27-1A16J-190-M	+27.3 \pm 2.5 VDC
5	COMPUTER MN B	C27-1A16J-191-J	C27-1A16J-191-A	+27.3 \pm 2.5 VDC
6	OPTICS MN B	C27-1A16J-191-G	C27-1A16J-191-H	+27.3 \pm 2.5 VDC
7	IMU MN B	C27-1A16J-191-D, E	C27-1A16J-191-B, C	+27.3 \pm 2.5 VDC
8	IMU HTR B	C27-1A16J-191-F	C27-1A16J-191-M	+27.3 \pm 2.5 VDC
9	VIEWER AC 1	C27-1A16J-190-K	C27-1A16J-190-N	115 \pm 10 VAC
10	VIEWER AC 2	C27-1A16J-190-K	C27-1A16J-190-N	115 \pm 10 VAC

6.1.3.8.2 Open the circuit breakers as listed in Table V on the S/C Right Hand Circuit Breaker Panel (breakers pulled out).

6.1.3.8.3 Demate Extended Cable Set from spacecraft power connector C27-1A16-J190 and C27-1A16-J191.

6.1.3.8.4 Mate connector 56P11 to connector C27-1A16-J190.

6.1.3.8.5 Mate connector 56P12 to connector C27-1A16-J191.

6.1.3.8.6 Mate connector 56P9 to connector 30A1J1 (G&N Signal Conditioner).

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6.2 Test Procedures

6.2.1 Application of Standby Power to G&N System

NOTE: Alarm and fail indications may occur in 6.2.1.6.1 and 6.2.1.8.2, while performing this test. Reset alarm by pressing the SYSTEM RESET pushbutton on the ICTC.

- 6.2.1.1 Verify that spacecraft power checks, to include polarity and magnitude on Spacecraft Power Connector, have been made as specified in 6.1.3.
- 6.2.1.2 All power and control switches on the G&N Indicator and Display Panel shall be placed in the OFF or neutral position.
- 6.2.1.3 The Inertial Component Temperature Controller (ICTC) Model No. 823-100, shall be supplying inertial component heater power to the G&N System through Tray No. 7 front panel connector 45A7J2.
- 6.2.1.4 Computer Power On
 - 6.2.1.4.1 Set the AGC MODE switch to ON position. Switch shall remain in the ON position unless specified otherwise as a procedural step.
 - 6.2.1.4.2 Set G&N COMPUTER MN A and MN B breakers on the Right Hand Circuit Breaker Panel to ON position (breakers pushed in). Record the value of CG 1520, AGC +28V on the CRT (24.5 V to 30.5V).
 - 6.2.1.4.3 Set the VIEWER AD 1 and AC 2 breakers on the Right Hand Circuit Breaker Panel to ON position (breakers pushed in).
 - 6.2.1.4.4 Set the computer numerical display lights to the desired brightness by rotating the BRIGHTNESS thumbwheel on the LEB AGC DSKY and MDC AGC DSKY.
 - 6.2.1.4.5 The AGC +28 VDC power discrete shall be issued (CG1523). This can be observed by the lighted AGC +26 VDC operate lamp on the Event Module.
 - 6.2.1.4.6 Ignore the computer alarm lights on the AGC DSKY panels. Enter VERB 36 in K 148. Press ENTER pushbutton. Press ERROR RESET pushbutton. All computer alarms on the Main Display Console (MDC) and LEB AGC DSKY shall clear.
 - 6.2.1.4.7 The voltage output of the +3 VDC AGC supply shall be +1.88 to +4.12 VDC, CG 1030. The value on CRT shall be recorded.
 - 6.2.1.4.8 The voltage output of the +13 VDC AGC supply shall be +11.7 to 14.3 VDC, CG 1020. The value on CRT shall be recorded.

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6.2.1.4.9 Verify that the AGC is in the Backup Mode by monitoring on CRT that the Program indicates 00, and the program readouts on the MDC and LEB AGC DSKY indicate 00.

6.2.1.4.10 Reset MASTER ALARM by pressing the MASTER ALARM LAMP.

6.2.1.4.11 Perform the following sequences on the LEB DSKY:

- a. Insert VERB 21, NOUN 02, Enter
- b. Insert 00041, Enter
- c. Insert 00000, Enter

6.2.1.4.12 Obtain E Memory Zeroing Tape No. F04C014-KD0012-00 and load the tape into the tape reader. Run the tape to the first STOP on the tape to zero erasable AGC memory locations.

6.2.1.4.13 Run the remaining portion of tape to initiate AGC Self Test. Wait approximately three minutes.

6.2.1.4.13.1 R1, R2, and R3 of DSKY will display contents of SCOUNT, SCOUNT+1 and SCOUNT+2 registers, respectively. Verify R1, R2, and R3 are incrementing in a positive direction every 67 + 2 seconds. Monitor R1, R2, and R3 until R1 equals 00003, and R2 and R3 equal 00002.

6.2.1.5 IMU HTR Heater Power on and Shorting Plug Verification

NOTE: 6.2.1.5.1 through 6.2.1.5.2 must be completed as quickly as possible. Under no condition should the elapsed time be greater than 15 minutes.

6.2.1.5.1 Remove all power to the ICTC. Remove the ICTC cable connected to connector 45A7J2 on Tray 7 of the PSA. Install the shorting plug 45A7P2.

6.2.1.5.2 Enter the IMU Standby Mode of operation by engaging the IMU HTR MN A and MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in). Record range time.

6.2.1.5.3 Verify that the IMU +28 VDC STANDBY discrete lamp on Event Module is lighted. (CG 1513)

6.2.1.5.4 Set ICTC Power ON-OFF switch to ON position.

NOTE: The alarm bells will ring during the following procedures until the PTC OFF ALARM RESET is pressed in.

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- 6.2.1.5.5 Remove 115 VAC from the Battery Power Pack.
- 6.2.1.5.6 Press the 115 V LINE/115V OFF ALARM RESET pushbutton.
- 6.2.1.5.7 Press the PTC OPERATING/PTC OFF ALARM RESET pushbutton.
- 6.2.1.5.8 Press the EMERGENCY pushbutton on the Battery Power Pack.
- 6.2.1.5.9 Verify that the BATTERY IN USE lamp is lighted on the Battery Power Pack.
- 6.2.1.5.10 Record the value of the following signals displayed on CRT:
- | Signal | Requirement |
|---------------------------------------|------------------|
| a. CG1301 2V 3200 CPS
POWER SUPPLY | +2.8 to +4.2 |
| b. CG1510 + 28 VDC
STANDBY POWER | 25.8 to 30.8 VDC |
| c. CG1511 +28 VDC
STANDBY NOISE | 0 to +0.7 VRMS |
- 6.2.1.5.11 The IRIQ TEMP and IMU HEATER CURRENT on CRT shall be monitored periodically for one hour to ensure that the IRIQ Temperature Control Loop circuitry is operating to maintain a temperature of 128.0°F to 134.5°F and current of 0.75 to 1.60 amperes (when current is applied) (CG2301) (2302).
- 6.2.1.5.12 The PIPA TEMP shall be monitored on CRT periodically for one hour to ensure that the PIPA Temperature Control Loop circuitry is operating to maintain a temperature of 128.0°F to 134.5°F (CG2300). (To be completed concurrently with 6.2.1.5.11).
- 6.2.1.5.13 The G&N System shall be in the Standby Mode for a minimum of one hour before proceeding with 6.2.1.6, Temperature Control Loop Tests. The test of 6.2.3, AGC Operation Test, may be performed during this period.
- 6.2.1.6 Temperature Control Loop Tests
- 6.2.1.6.1 Verify that the IMU TEMP MODE switch on the G&N Indicator Control Panel is set to AUTO OVERRIDE Position.
- 6.2.1.6.2 IRIQ Temperature Bridge Calibration Test.

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- 6.2.1.6.2.1 Press and hold ZERO pushbutton on the G&N Indicator Control Panel.
- 6.2.1.6.2.2 IRIG Temperature Indicating Bridge Amplifier output shall be 132.9°F to 134.1°F (CG2301). Record indication of IRIG TEMP as displayed on CRT.
- 6.2.1.6.2.3 Release ZERO pushbutton. The IRIG Temperature Indication Bridge Amplifier output shall be 128.0°F to 134.5°F (CG2301). Record as displayed on CRT of IRIG TEMP meter on Meter Module.
- 6.2.1.6.3 IRIG Temperature Bridge Gain Test
- 6.2.1.6.3.1 Press and hold IRIG GAIN pushbutton on G&N Indicator Control Panel. The IMU TEMP condition lamp shall be lighted.
- 6.2.1.6.3.2 The IRIG Temperature Indicating Bridge Amplifier output shall be 127.9°F to 129.1°F (CG2301). Record indication of IRIG TEMP as displayed on CRT.
- 6.2.1.6.4 PIPA Temperature Bridge Calibration Test
- 6.2.1.6.4.1 Press and hold ZERO pushbutton on the G&N Indicator Control Panel.
- 6.2.1.6.4.2 The PIPA Temperature Indicating Bridge Amplifier output shall be 129.4°F to 130.6°F (CG2300). Record indication of PIPA TEMP as displayed on CRT.
- 6.2.1.6.5 PIPA Temperature Bridge Gain Test
- 6.2.1.6.5.1 Press and hold PIPA GAIN pushbutton on G&N Indicator Control Panel, and record indication on PIPA TEMP as displayed on CRT (CG2300).
- 6.2.1.6.5.2 IMU TEMP condition lamp shall be lighted.
- 6.2.1.6.5.3 The PIPA Temperature Indicating Bridge Amplifier output shall be 134.4°F to 135.6°F.
- 6.2.1.6.5.4 Release PIPA GAIN pushbutton, and record indication of PIPA TEMP as displayed on CRT (CG2300).
- 6.2.1.6.5.5 IMU TEMP condition shall not be lighted.
- 6.2.1.6.5.6 The PIPA Temperature Indicating Bridge Amplifier output shall be 128.0°F to 134.5°F.

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6.2.1.7 Temperature Control Using the ICTC and the Removal of Shorting Plug

NOTE: 6.2.1.7.1 through 6.2.1.7.3 must be completed in less than 15 minutes.

- 6.2.1.7.1 Remove standby power by opening the IMU HTR breakers MN A and MN B on the Right Hand Circuit Breaker Panel (breaker pulled out). The +28 VDC STANDBY lamp on Event Module shall not be lighted (CG 1513).
- 6.2.1.7.2 Remove shorting plug 45A7P2 from connector 45A7J2 on PBA Tray 7. Install the cable from the PTC/ICTC to this connector.
- 6.2.1.7.3 Apply 115 VAC to the Battery Power Pack.
- 6.2.1.7.4 Press the 115 V LINE/115 V OFF ALARM RESET pushbutton.
- 6.2.1.7.5 Press the PTC OPERATING/PTC OFF ALARM RESET pushbutton on the Battery Power Pack.
- 6.2.1.7.6 Verify that the 115V LINE power lamp and the PTC power lamp are lighted.
- 6.2.1.7.7 Verify PTC OFF ALARM RESET lamp is not lighted.
- 6.2.1.7.8 Verify temperature on ICTC Temperature Meter is $135 \pm 5^{\circ}\text{F}$.
- 6.2.1.7.9 Verify current reading on ICTC Current Meter is 1.0 ± 0.75 amps.
- 6.2.1.7.10 Enter Standby Mode of operation by engaging the IMU HTR MNA and MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in). Reset ICTC alarm, if it is turned on.
- 6.2.1.7.11 Verify presence of the +28 VDC IMU STANDBY discrete (CG1513) by noting that the +28 VDC STANDBY discrete lamp on Event Module is lighted.
- 6.2.1.7.12 After a minimum of two hours in the Standby Mode, the following temperatures and current shall be recorded.
 - 6.2.1.7.12.1 Record the IRIQ and PIPA temperatures as displayed on CRT. (CG2301, CG2300).
 - 6.2.1.7.12.1.1 The IRIQ Temperature shall be 128.6°F to 138.3°F (CG2301).
 - 6.2.1.7.12.1.2 The PIPA Temperature shall be 125.1°F to 134.8°F (CG2300).
 - 6.2.1.7.12.2 Record the IMU Heater current as displayed on CRT.
 - 6.2.1.7.12.2.1 The Heater current shall be 0.75 to 1.60 amperes (CG2302). (only when current is applied).

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6.2.2 General Turn Off and Turn On Procedure

NOTE: This procedure shall be utilized any time after performing 6.1.3 Pre-power Application Requirements, 6.2.1, Standby Power On Test, and 6.2.4, Operate Power On Test, to turn on or turn off the G&N System. Appropriate portions of this procedure will be referenced in other tests.

6.2.2.1 Turn OFF Procedure

CAUTION

This procedure must be followed in the order specified. Failure to adhere to this procedure may require recalibration of the inertial components.

6.2.2.1.1 Verify or place the TRANSFER switch on the IMU CONTROL Panel to the COMPUTER position.

6.2.2.1.2 Enter the following values into K148 in the listed sequence:

- a. Insert VERB 41 NOUN 20 and verify. Press the ENTER pushbutton.
- b. Insert +00000 and verify. Press the ENTER pushbutton.
- c. Insert -05700 and verify. Press the ENTER pushbutton.
- d. Insert +09000 and verify. Press the ENTER pushbutton.

6.2.2.1.3 Verify that the COARSE ALIGN MODE lamp on the IMU CONTROL panel is the only MODE lamp that is lighted. Wait 60 seconds.

6.2.2.1.4 Place the TRANSFER Switch on the IMU CONTROL to the MANUAL position.

6.2.2.1.5 Set the following switches on the G&N Indicator Control Panel to the positions designated.

- a. SLAVE TELESCOPE to STAR LOS
- b. OPTICS MODE to ZERO OPTICS
- c. CONTROLLER MODE to DIRECT
- d. CONTROLLER SPEED to LO
- e. POWER AND BRIGHTNESS to OFF
- f. ATTITUDE IMPULSE ENABLE to OFF
- g. IMU TEMP MODE to AUTO-OVERRIDE

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- 6.2.2.1.6 Set the G&N OPTICS MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OPEN position (breakers pulled out).
- 6.2.2.1.7 Set the G&N IMU, MNA and MN B breakers on the Right Hand Circuit Breaker Panel to OPEN position (breakers pulled out).
- 6.2.2.1.8 The BRIGHTNESS thumbwheel on AGC-DSKY-LEB (lower Equipment Bay) and AGC DSKY-MDC (Main Display Console) shall be decreased to its minimum brightness - OFF position.
- 6.2.2.1.10 Set the G&N COMPUTER MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF position (breakers pulled out).
- 6.2.2.1.11 Set the G&N VIEWER AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to OFF position (breakers pulled out).
- 6.2.2.1.12 Set ICTIC POWER ON-OFF switch to ON. Press ALARM RESET switch and verify ALARM RESET lamp is not lighted. Verify that the ICTC is supplying inertial component heater power to the G&N System as indicated by the PTC HEATER POWER lamp illuminated on the PTC. Verify the temperature is within $135 \pm 5.0^\circ\text{F}$ and the current is within 1 ± 0.75 amperes on the PTC meter.
- 6.2.2.2 Turn On Procedures
- 6.2.2.2.1 Set or verify the following switches on the G&N Indicator Control Panel to the positions designated.
- a. SLAVE TELESCOPE to SEAR LOS
 - b. OPTICS MODE to ZERO OPTICS
 - c. CONTROLLER MODE to DIRECT
 - d. CONTROLLER SPEED to LO
 - e. POWER AND BRIGHTNESS to OFF
 - f. ATTITUDE IMPULSE ENABLE TO OFF
 - g. IMU TEMP MODE to AUTO OVERRIDE
- 6.2.2.2.2 Ensure that SYNC switch on the MDC Panel 25 is in the OFF position.
- 6.2.2.2.3 Ensure that interfacing systems EPS and ECS are turned on and operating properly.

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- 6.2.2.2.4 Ensure that the TRANSFER switch on the IMU CONTROL panel is set to MANUAL position.

CAUTION

The remaining procedure must be followed in the order specified. Failure to adhere to this procedure may require recalibration of the inertial components.

- 6.2.2.2.5 Energize the G&N VIEWER AC 1 and AC 2 breakers on the Right Hand Circuit Breaker panel (breakers pushed in).
- 6.2.2.2.6 Ensure that the AGC MODE switch is set to ON position.
- 6.2.2.2.7 Energize the G&N COMPUTER MN A and MN B breakers on the Right Hand Circuit Breaker panel (breakers pushed in). Ensure that the AGC +28 VDC discrete lamp on Event Module is lighted (CG 1523). Verify that the secondary AGC power supply voltages on the CRT, display the following requirements:
- a. CG 1020 +13 VDC AGC Supply +11.7 to +14.3 VDC
 - b. CG 1030 + 3 VDC AGC Supply +1.88 to +4.12 VDC
- 6.2.2.2.8 Disregard all alarm indications on the AGC DSKY panels. Enter VERB 36 into K148. Press ENTER pushbutton. Press ERROR RESET pushbutton. All computer alarms on the Main Display Console (MDC) and LEB AGC DSKY shall clear. Verify register R1, R2, and R3 on the AGC DSKY's are cleared.
- 6.2.2.2.9 Set the computer display lights to the minimum usable brightness by rotating the BRIGHTNESS thumbwheels on the LEB AGC DSKY and MDC AGC DSKY.
- 6.2.2.2.10 On G&N Facility Interface Box, set the switch to FIRE ALARM BY-PASS Position.
- 6.2.2.2.11 Energize the G&N IMU HTR MN A and MN B breakers on the Right Hand Circuit Breaker panel (breakers pushed in).
- 6.2.2.2.12 Verify that the IMU +28 VDC STANDBY discrete lamp on Event Module is lighted (CG 1513).
- 6.2.2.2.13 Reset ICTC alarm if alarm indication is present. Reset ICTC alarm. Verify ICTC ON/OFF switch to ON position.
- 6.2.2.2.14 Perform the following sequences on the LEB DSKY:
- a. Insert VERB 21, NOUN 01, ENTER
 - b. Insert 00041, ENTER
 - c. Insert 00000, ENTER

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- 6.2.2.2.15 Obtain E. Memory Zeroing Tape No. F04C014-K00012-00 and load tape into the tape reader. Run the tape to the first STOP on the tape to zero erasable AGC memory locations.
- 6.2.2.2.16 Run the remaining portion of Tape No. F04C014-K00012-00 to initiate AGC Self Test. Wait approximately three minutes.
- 6.2.2.2.16.1 Verify FAILURE DETECT lamp on Event Module 4A3 is not lighted.
- 6.2.2.2.16.2 Verify G&N ERROR lamp on MDC Panel 10 is not lighted.

NOTE: Anytime when VERB 36 is entered G&N ERROR lamp on MDC Panel No. 10 and FAILURE DETECT lamp on Event Module 4A3 will light.

- 6.2.2.2.16.3 R1, R2, and R3 of DSKY will display contents of SCOUNT, SCOUNT +1 and SCOUNT +2 registers, respectively. Verify R1, R2, and R3 are incrementing in a positive direction every 67 ± 2 seconds.

NOTE: If Standby Power (G&N IMU HTR with G&N computer breakers) has been off for two hours or more allow two hours warm up before proceeding. If the G&N System has been off for less than two hours, allow an equal time period for warm up before proceeding.

- 6.2.2.2.17 After required warm up time has elapsed, set the G&N IMU MN A and MN B breakers on the Right Hand Circuit Breaker panel to ON position (breakers pushed in). Press the COARS ALIGN pushbutton on the IMU Control Panel. Ensure that the IMU +28 VDC OPERATE (ON) lamp on Event Module is lighted. (CG 1503). Verify that the value CG 1500, IMU +28 V on the CRT (+24.5 to +30.5 VDC). The gimbal lock lamp on the Conditioner Annunciator is lighted.
- 6.2.2.2.18 Ensure that the IMU DELAY lamp on the Condition Light Annunciator Panel is lighted and the IMU DELAY lamp on Event Module is lighted (CG 5008).

NOTE: Perform 6.2.2.2.19 only if performance of 6.2.4, 6.2.10, 6.2.11, 6.2.12, 6.2.13, 6.2.20 and 6.2.21 is anticipated.

- 6.2.2.2.19 Set the G&N OPTICS MN A and MN B breakers on the Right Hand Circuit Breaker Panel to ON position (breaker pushed in). Ensure that the OPTX +28 VDC discrete lamp on Event Module is lighted. (CG 1533)
- 6.2.2.2.20 Verify the value CG 1530, OPTX +28V on the CRT (+25 to 30.8 VDC). * Verify that the secondary power supply voltages of the following signals as displayed on the CRT is as indicated in Table VI.

* Only if 6.2.2.2.19 is performed.

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TABLE VI. SECONDARY POWER SUPPLY VOLTAGES

Meas. No.	Signal	Requirement
a. CG 1000	+120 VDC IRIQ Supply	+112.0 to +146 VDC
b. CG 1003	+12 VDC IRIQ Supply	+10.6 to +13.4 VDC
c. CG 1006	+32 VDC IRIQ Supply	+25.5 to +35.5 VDC
d. CG 1010	+120 VDC PIPA Supply	+107 to +145 VDC
e. CG 1016	+32 VDC PIPA Supply	+25.5 to +35.5 VDC
f. CG 1101	-28 VDC ELECTRONICS	-21.3 to -33.7 VDC
g. CG 1201	IMU 28 V 800 CPS 1% 0°	+27 to +29 VRMS
h. CG 1202	IMU 28V 800 CPS 5%-90°	+26.1 to +29.9 VRMS
i. CG 1203	IMU 28V 800 CPS 5%-0°	+24.7 to +30.3 VRMS
j. CG 1204	CDU 28 800 CPS 5%-90°	+26.1 to +29.9 VRMS
k. CG 1301	IMU 2V 3200 CPS SUPPLY	2.8 to 4.2 VRMS
l. CG 1302	20V 3200 CPS SQ WAVE	+15.6 to +24.4 VRMS
m. CG 1400	IMU 2.5V 25.6 KC in ϕ	+2.1 to +2.9 VRMS
n. CG 1110	+2.5 VDC T/M REFERENCE	+2.45 to +2.55 VDC
* o. CG 1211	OPTX 28V 800 CPS 1%-0°	+27 to +29 VRMS
* p. CG 1212	OPTX 800 CPS 5%-90°	+26.1 to +29.9 VRMS'
* q. CG 1401	OPTX 2.5V 25.6 KC in ϕ	+2.1 to +2.9 VRMS

*Only if 6.2.2.2.19 is performed.

6.2.2.2.21 Set the TRANSFER switch on the IMU CONTROL panel to COMPUTER.

6.2.2.2.22 Enter and verify VERB 41, MOUN 20 into K148. Press ENTER pushbutton to advance System to COARS ALIGN mode. The VERB-MOUN display on CRT shall flash and indicate 21-22.

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6.2.2.2.23 Enter and verify +00000 into K148 three times pressing the ENTER pushbutton on the K148 after each entry. The COARS ALIGN MODE lamp on the IMU CONTROL panel shall be the only MODE lamp that is lighted. The G&N ERROR lamp on the Condition Annunciator may be on.

6.2.2.2.24 Monitor the signals listed below on a CRT to ensure that the IMU is not in a Gimbal Lock pondition. The signal shall indicate no gimbal oscillation movement.

	Meas. No.	Signal	Requirement
a.	CG 5003	GIMBAL LOCK WARNING	OFF
b.	CG 2142	MI CDU LX RES SINE	Not Oscillating
c.	CG 2143	MI CDU LX RES COSINE	Not Oscillating

6.2.2.2.25 Monitor the signals listed below on the CRT to verify normal PIPA loop operation.

a.	CG 2202	X PIPA SG OUT QUAD	Less than 0.66 VRMS
b.	CG 2022	Y PIPA SG OUT QUAD	Less than 0.66 VRMS
c.	CG 2042	Z PIPA SG OUT QUAD	Less than 0.66 VRMS

6.2.2.2.26 Perform 6.2.6 G&N Operational Test

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6.2.3 AGC Operational Test

NOTE: This test shall be performed only when IMU HTR and Computer powers are supplied. Test shall not be performed when IMU operate power is applied.

6.2.3.1 Verify IMU STANDBY power (including AGC operate power) is applied and IMU OPERATE power is not applied, and that AGC MODE switch is ON.
(G&N IMU HTR MN A and MN B breakers engaged (breakers pushed in) computer MN A and MN B breakers engaged (breakers pushed in) IMU MN A and MN B breakers disengaged (breakers pulled out)).

6.2.3.1.1 Set the TRANSFER switch in MANUAL position on the IMU Control Panel.

6.2.3.1.2 Using LEB AGC DSKY, enter VERB 36. Press ENTER pushbutton. Press ERROR RESET on the LEB DSKY.

6.2.3.2 AGC Interface Checks

6.2.3.2.1 Enter the following sequence into the LEB AGC DSKY to initiate the DSKY test:

a. VERB 57 ENTER

b. 00007 ENTER

6.2.3.2.2 Observe all 9's displayed in the MAJOR MODE, VERB, NOUN and R1, R2 and R3 character positions and that the UPTL lamp is lighted.
At approximately 10 second intervals, the following is displayed in the above character positions except where noted.

a. 8's

b. 7's

c. 6's

d. 5's

e. 4's

f. 3's

g. 2's

h. 1's

i. 0's

j. all positions blank

k. MINUS signs in R1 R2 and R3

l. PLUS signs in R1 R2 and R3 with the PROGRAM ALARM, TM FAIL, KEY RELEASE, CHECK FAIL and momentarily COMPUTER ACTIVITY lamps lighted.

m. UPTL lamp not lighted

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6.2.3.2.2.1 Press ERROR RESET and KEY RELEASE pushbuttons. The KEY RELEASE and AOC alarm lamps shall not be lighted.

6.2.3.2.3 DSKY Pushbutton Check

6.2.3.2.3.1 Enter VERB 25, NOUN 02 into LEB AOC DSKY. Press ENTER pushbutton.

6.2.3.2.3.2 Enter 01775 into LEB AOC DSKY. Press ENTER pushbutton.

6.2.3.2.3.3 Enter +00123 into LEB AOC DSKY. Press ENTER pushbutton.

6.2.3.2.3.4 Enter -00456 into LEB AOC DSKY. Press ENTER pushbutton.

6.2.3.2.3.5 Enter -00789 into LEB AOC DSKY. Press ENTER pushbutton.

6.2.3.2.3.6 Verify that +00123 is displayed in R1, -00456 is displayed in R2 and -00789 is displayed in R3 in the LEB and MDC AOC DSKY's.

6.2.3.2.3.7 Enter VERB 05, NOUN 02 into LEB AOC DSKY. Press ENTER pushbutton.

6.2.3.2.3.8 Enter 01775 into LEB AOC DSKY. Press ENTER pushbutton.

6.2.3.2.3.9 The LEB and MDC AOC DSKY's shall indicate 00178 in R1, 77067 in R2, and 76352 in R3. Verify the displays.

6.2.3.2.3.10 Repeat 6.2.3.2.3.1 through 6.2.3.2.3.9 using the MDC AOC DSKY.

6.2.3.2.4 C - Relay Check

NOTE: ACCEL FAIL, IMU FAIL, CDU FAIL and ZERO ENCODER lamps on Condition Annunciator panel will light intermittently during this test.

6.2.3.2.4.1 Enter the following sequence into MDC or LEB AOC DSKY to initiate the C-Relay Test:

- | | |
|--------------------|-------|
| a. VERB 15 NOUN 01 | ENTER |
| b. 00722 | ENTER |
| c. VERB 57 | ENTER |
| d. 00006 | ENTER |

6.2.3.2.4.2 Press KEY RELEASE pushbutton after KEY RELEASE lamp lights. Rows R1, R2 and R3 shall display the contents of DSPTAB +11D, (R1), DSPTAB +12D, (R2), DSPTAB +13D, (R3).

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6.2.3.2.4.3 The DISTAB registers will count in the sequence 1, 2, 4, 10, 20, 40, 100, 200, 400, 1000, 2000, beginning with the register in R3, then R2 and finally R1. IN3 will then be displayed. Verify that the above sequence is followed throughout the test and that the final display of R3 is 00001 and IN3 register in R1 shall display one of the following: 0XXXX, 1XXXX, 2XXXX, and 3XXXX.

6.2.3.2.4.4 If an error exists, the PROGRAM ALARM lamp will be lighted and a VERB-NOUN display of 01-33 will flash and R1 on the CRT or DSKY will display 01103 or 41103 for multiple failures. Record.

6.2.3.3 AGC Alarms and Interrupt Test

NOTE: During the following test disregard AGC Alarm indications which are not noted on the test.
After each Error Reset for a test sequence insure all alarm lamps are not lighted.

6.2.3.3.1 Obtain CAM Alarms and Interrupts Test Tape No. F04C014-K00020-00 and load the tape on TAPE READER.

6.2.3.3.2 Set the POWER/ON switch on the TAPE READER 4A4-A2 to ON. Perform the following steps on Console 4A4-A3 in sequence:

- Press the TAPE/KEY indicator to TAPE
- Press the FWD/REV indicator to FWD
- Press the IND/CONF indicator to CONF
- Press the LOAD/INH indicator to LOAD

6.2.3.3.3 Computer Activity

6.2.3.3.3.1 Press the RUN indicator switch on to RUN. Wait until tape stop.

6.2.3.3.3.2 Verify R1 indicates 00001 on CRT.

6.2.3.3.3.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.3.4 Verify that the COMPUTER ACTIVITY lamps on the MDC and LEB DSKY's and Event Module are lighted. The lamps shall remain lighted for approximately 10 seconds (CG 5021).

6.2.3.3.4 TC Trap (Due to constant TC instruction or an extended period without a TC instruction being generated)

6.2.3.3.4.1 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

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- 6.2.3.3.4.2 Verify RI indicates 00002 on CRT.
- 6.2.3.3.4.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.
- 6.2.3.3.4.4 The TC TRAP alarm light shall be lighted. Verify indications on the LEB DSKY and Event Module (CG 5029). Press ERROR RESET pushbutton.
- 6.2.3.3.4.5 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.
- 6.2.3.3.4.6 Verify RI indicates 00003 on CRT.
- 6.2.3.3.4.7 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.
- 6.2.3.3.4.8 The TC TRAP alarm light shall be lighted. Verify indication on LEB DSKY and Event Module (CG 5029). Press ERROR RESET.
- 6.2.3.3.5 RUPT LOCK (Due to extended or infrequent interrupts)
- 6.2.3.3.5.1 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.
- 6.2.3.3.5.2 Verify RI indicates 00004 on CRT.
- 6.2.3.3.5.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.
- 6.2.3.3.5.4 The RUPT LOCK alarm light shall be lighted. Verify indication on LEB DSKY, Event Module, and CRT (CG 5028). Disregard all other alarm indications. Press ERROR RESET.
- 6.2.3.3.5.5 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.
- 6.2.3.3.5.6 Verify RI indicates 00005 on CRT.
- 6.2.3.3.5.7 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.
- 6.2.3.3.5.8 The RUPT LOCK alarm light shall be lighted. Verify indication on LEB DSKY, Event Module, and CRT (CG 5028). Disregard all other alarm indications. Press ERROR RESET.

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6.2.3.3.6 Parity Fail

- 6.2.3.3.6.1 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until the tape stops.
- 6.2.3.3.6.2 Verify that R1 indicates 00006 on CRT.
- 6.2.3.3.6.3 Press the RUN indicator on 4A4-K148 to RUN. Wait until the tape stops.
- 6.2.3.3.6.4 Verify that PARITY ALARM has been generated and displayed on the MDC and the LEB DSKY's and that the EVENT MODULE is lighted. Disregard all or any other alarm indications. Press ERROR RESET.

6.2.3.3.7 TELEMETRY FAIL ALARM

- 6.2.3.3.7.1 Press RUN indicator switch on 4A4-K148 to RUN. Wait until the tape stops.
- 6.2.3.3.7.2 Verify that R1 displays 00007 on the CRT.
- 6.2.3.3.7.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until the tape stops.
- 6.2.3.3.7.4 Verify that the TELEMETRY FAIL alarm is illuminated in the MDC and the LEB DSKY.
- 6.2.3.3.7.5 Verify that SEAL is indicated on the K-START module. Press ERROR RESET to clear AOC DSKY's.
- 6.2.3.3.7.6 Insert Verb 36 and ENTER into LEB DSKY. Insert VERB 21 NOUN 02 and ENTER into LEB DSKY. Insert 00041 and ENTER into LEB DSKY. Insert 00000 and ENTER into LEB DSKY.
- 6.2.3.3.8 Check Fail
 - 6.2.3.3.8.1 Insert the following into the LEB DSKY to generate a CHECK FAIL:
 - a. VERB 21 NOUN 01 ENTER
 - b. 00008 ENTER
 - c. Press ERROR RESET on LEB DSKY.

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6.2.4 Operate Power on and Power Supply Test

CAUTION

- a. Insure that the SYNC switch on MDC panel 25 is in the OFF position.
- b. The sequence specified in steps 6.2.4.1 through 6.2.4.6.10 must be adhered to. Deviation may necessitate recalibration of inertial components.

6.2.4.1 G&N breakers on the Right Hand Circuit Breaker Panel shall be in the following positions:

- a. COMPUTER MN A and MN B breakers ON (Breakers pushed in).
- b. IMU HTR MN A and MN B breakers ON (Breakers pushed in).
- c. IMU MN A and MN B breakers OFF (Breakers pulled out.)
- d. OPTICS MN A and MN B breakers OFF (Breakers pulled out).
- e. VIEWER AC1 and AC2 breakers ON (Breakers pushed in).
- f. G&N VIEWER toggle switch in AC1 (up).

6.2.4.2 The TRANSFER switch on the IMU CONTROL Panel shall be in MANUAL position.

6.2.4.3 The AGC MODE switch on AGC shall be set to ON position.

6.2.4.4 Switches and selectors on the G&N Indicator Control panel shall be set to the following positions:

- a. SLAVE TELESCOPE to STAR LOS
- b. OPTICS MODE to ZERO OPTICS
- c. CONTROLLER MODE to DIRECT
- d. CONTROLLER SPEED to LO
- e. POWER and BRIGHTNESS to OFF
- f. ALTITUDE IMPULSE ENABLE to OFF
- g. PANEL BRIGHTNESS to maximum increase
- h. IMU TEMP MODE to AUTO OVERRIDE

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6.2.4.5 IMU Operate Power

NOTE: Prior to switching to IMU Operate, the G&N System shall have been on Standby Mode with AGC power applied, for a minimum of two hours.

6.2.4.5.1 Set up the Analog Recorder 4A3-A2 and the switches on the Analog Select Panel 4A3-A3 to monitor the following signals:

- a. CG 2206 IGA CDU LX RES ERR
- b. CG 2236 MGA CDU LX RES ERR
- c. CG 2266 OGA CDU LX RES ERR

6.2.4.5.2 Start analog recorder using a chart speed of 5 MM/SEC. Start Event Recorder chart drive using chart speed of 10 MM/SEC. Prepare to mark the strip chart on analog recorder at the time IMU DELAY lamp extinguishes.

6.2.4.5.3 With the IMU in Standby Mode, the IMU Operate Power shall be applied by actuating the G&N IMU MN A and MN B breakers on the Right Hand Circuit Breaker Panel (breaker-pushed in). Press COARS ALIGN mode lamp on IMU Control Panel.

6.2.4.5.4 IMU DELAY lamps on the Condition Annunciator Panel, and Event Module shall be lighted when IMU Operate Power is applied (CG 1503). The IMU DELAY lamp shall extinguish after a time delay of 100 ± 10 seconds (CG 5008).

6.2.4.5.5 The COARS ALIGN (Coarse Align), MODE lamp on the IMU CONTROL Panel shall be lighted when IMU Operate power is switched on. After a time delay of 100 ± 10 seconds, the COARS ALIGN lamp shall remain lighted. The gimbal lock Lamp on Condition Annunciator panel may be lighted.

6.2.4.5.6 After the IMU DELAY lamps go out, mark the strip chart, stop the Event Recorder, and record the time at which the IMU DELAY lamp is extinguished.

6.2.4.5.7 Stop the Analog Recorder 4A3-A2. Record the time at which the initial transient on OGA CDU LX Resolver Error signals occurred from Analog Recorder 4A3-A2.

6.2.4.5.8 Determine elapsed time between OGA LX resolver initial transient and IMU DELAY lamp going out from the recorders.

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- 6.2.4.5.9 Just prior to the time when the IMU DELAY lamp extinguishes, the Outer, Middle, and Inner IMU-CDU LX Resolver mulls shall be less than 0.600 VRMS (CG 2266, CG 2236, and CG 2206). Record the amplitude of all CDU LX resolver signals from Analog Recorder 4A3-A2.
- 6.2.4.5.10 IMU +28 VDC OPERATE discrete shall be issued (YG 1503) by observing that the IMU OPERATE lamp on Event Module is lighted. Record the value of CG 1500, IMU +28V on the CRT (+24.5 to 30.5 VDC).
- 6.2.4.6 Optics Power On
- 6.2.4.6.1 Optics power shall be applied by actuating the G&N OPTICS MN A and OPTICS MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).
- 6.2.4.6.2 OPTICS +28 VDC discrete shall be issued (CG 1533) by observing that the OPTICS lamp on Event Module is lighted. Record the value of CG 1530, OPTX +28V on the CRT (+24.5 to 30.5 VDC).
- 6.2.4.6.3 Verify that the ZERO ENCODER on the Condition Annunciator Panel is lighted for no more than 90 seconds after Optics Power Turn On.
- 6.2.4.6.4 The SHAFT ANGLE and TRUNNION ANGLE adjacent to the Scanning Telescope eyepiece shall be 0.0 ± 1.0 degree.
- 6.2.4.7 Set TRANSFER switch on the IMU CONTROL panel to COMPUTER. Disregard all computer alarms. Enter VERB 36, press ENTER pushbutton, then press ERROR RESET pushbutton. All alarms shall clear.
- 6.2.4.8 Enter and verify VERB 41, NOUN 20 into K148. Press ENTER pushbutton to advance system to COARSE ALIGN under AGC control. The VERB NOUN display on CRT shall flash and indicate 21-22.
- 6.2.4.9 Enter and verify +00000 into K148 three times, pressing the ENTER pushbutton after each entry. The COARSE ALIGN mode lamp on the IMU CONTROL panel shall be the only MODE lamp lighted. Insure that gimbal Lock lamp on Condition Annunciator panel is not lighted.
- 6.2.4.10 Secondary Power Supply Voltages, Noise Peaks and Phase Difference

NOTE: Ensure that the IMU Operate Power has been on for a minimum of 15 minutes before proceeding with this test.

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6.2.4.10.1 Record the secondary power supply voltages of the following signals displayed on the CRT.

<u>Item No.</u>	<u>Measurement No.</u>	<u>Signal</u>	<u>Requirement</u>
a.	CG 1000	+120 VDC IRIG SUPPLY	+112 to +146 VDC
b.	CG 1003	+ 12 VDC IRIG SUPPLY	+10.6 to +13.4 VDC
c.	CG 1006	+ 32 VDC IRIG SUPPLY	+25.5 to +35.5 VDC
d.	CG 1010	+120 VDC PIPA SUPPLY	+107 to +145 VDC
e.	CG 1016	+ 32 VDC PIPA SUPPLY	+25.5 to +35.5 VDC
f.	CG 1020	+ 13 VDC AGC SUPPLY	+11.7 to +14.3 VDC
g.	CG 1030	+ 3 VDC AGC SUPPLY	+1.88 to +4.12 VDC
h.	CG 1101	- 28 VDC SUPPLY	-33.7 to -21.3 VDC
i.	CG 1110	+2.5 VDC TM BIAS	+2.45 to +2.55 VDC
j.	CG 1301	IMU 2V 3200 CPS SUPPLY RMS	2.8 to 4.2 VRMS
k.	CG 1400	IMU 2V 25.6 KC SUPPLY IN PH	+2.1 to +2.9 VRMS
l.	CG 1401	OPTX 2V 25.6 KC SUPPLY IN PH	+2.1 to +2.9 VRMS
m.	CG 1201	IMU 28V .8 KC 1 PCT 0 Deg SUP RMS	+27 to +29 VRMS
n.	CG 1202	IMU 28V .8KC 5 PCT 90 Deg SUP RMS	+26.1 to +29.9 VRMS
o.	CG 1203	IMU 28V .8 KC 5 PCT 0 Deg SUP RMS	+24.7 to +30.3 VRMS
p.	CG 1204	CDU 28V .8 KC PCT 90 Deg SUP RMS	+26.1 to +29.9 VRMS
q.	CG 1211	OPTX 28V .8 KC 1 PCT 0 Deg SUP RMS	+27 to 29 VRMS
r.	CG 1212	OPTX 28V .9 KC 5 PCT -90 Deg SUP RMS	+26.1 to +29.9 VRMS
s.	CG 1302	20V 3.2 KC SQ WAVE SUPPLY RMS	+15.6 to +24.4 VRMS

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6.2.4.10.2 Record the noise peaks of the following signals displayed on the CRT:

Item No.	Meas't No.	Signal	Requirement
a.	CG 1001	+120 VDC IIRIG NOISE RMS	Less than +1.00VRMS
b.	CG 1011	+120 VDC PIPA NOISE RMS	Less than + 1.0 VRMS
c.	CG 1021	+ 13 VDC AGC NOISE RMS	Less than 0.65 VRMS
d.	CG 1031	+ 3 VDC AGC NOISE RMS	Less than 0.65 VRMS
e.	CG 1501	+ 28 VDC No. 1 NOISE RMS	Less than + 0.70 VRMS
f.	CG 1511	+ 28 VDC No. 2 NOISE RMS	Less than + 0.70 VRMS
g.	CG 1521	+ 28 VDC No. 3 NOISE RMS	Less than + 0.70 VRMS
h.	CG 1531	+ 28 VDC No. 4 NOISE RMS	Less than + 0.70 VRMS

6.2.4.10.3 Record the phase difference of the following signals displayed on the CRT:

a.	CG 1206	PH DIF IMU 1 $\frac{1}{2}$ 0°, IMU 5 $\frac{1}{2}$ 90°	-77.0 to -103°
b.	CG 1207	PH DIF IMU 5 $\frac{1}{2}$ 0°, IMU 5 $\frac{1}{2}$ 90°	-77.0 to -103°
c.	CG 1306	PH DIF IMU 2V 3.2KC AGC SYNC	-12.5 to +12.5°
d.	CG 1209	PH DIF IMU 1 $\frac{1}{2}$ 0° CDI 5 $\frac{1}{2}$ 90°	-77 to -103°
e.	CG 1220	PH DIF IMU 1 $\frac{1}{2}$ 0° OPTX 1 $\frac{1}{2}$ 0°	-12.5 to +12.5°
f.	CG 1402	PH DIF IMU 25.6KC OPTX 25.6KC	-32 to +32°
g.	CG 1216	PH DIF OPTX 1 $\frac{1}{2}$ 0° OPTX 5 $\frac{1}{2}$ 90°	-77 to -103°

6.2.4.10.4 The noise peaks of the following signals are demonstrated on the event lights when the peak voltage exceeds 5 volts and is present for more than one microsecond.

			Event Module
a.	CG 1022	+13 VDC AGC NOISE PEAK	4A3-A5
b.	CG 1032	+ 3 VDC AGC NOISE PEAK	4A3-A5
c.	CG 1502	+28 VDC No. 1 NOISE PEAK	4A3-A5
d.	CG 1512	+28 VDC No. 2 NOISE PEAK	4A3-A5
e.	CG 1522	+28 VDC No. 3 NOISE PEAK	4A3-A5
f.	CG 1532	+28 VDC No. 4 NOISE PEAK	4A3-A5

6.2.4.10.5 Perform 6.2.6 G&N Operational Test.

6.2.4.10.6 Optics power shall be removed by actuating the G&N OPTICS MNA and MNB breakers on the Right Hand Circuit Breaker panel to off (breakers pulled out).

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6.2.5 Failure Indicating Circuitry Test

6.2.5.1 Proceed with this test of 6.2.4 Operate Power On Test has been completed. If system power is on, perform 6.2.2.1 before proceeding. If system power is off, proceed to 6.2.5.2.

NOTE: Ensure that the following cables which supply heater power to the IMU are not disconnected.

- a. Ensure that 1901529 cable is connected from 45A7J2 on PSA TRAY 7 to J11 on A23-201 PSA Adapter Module.
- b. C14-462 cable connected between J2 on A23-201 PSA Adapter Module and J6 on ICTC.

NOTE: Utilize a portable table or equivalent support to set the 190808-011 Heat Sink, 1900809-011 Failure Indicator Tester, 1900806-011 Breakout Box and PSA Tray 2 when removed.

6.2.5.2 Disconnect PSA Adapter connector from PSA trays (Connectors J1 through J10) except 1902438 cable connected to 45A7J2 on PSA Tray 7.

6.2.5.3 Disengage holding screws and carefully remove A23-201 away from the Power Servo Assembly unit. There is sufficient clearance to remove PSA Tray 2.

6.2.5.4 Disengage captivated screw on PSA Tray 2 from PSA toe cap.

6.2.5.5 Remove PSA Tray 2 from Servo Assembly and place on 1900808-011 Heat Sink.

6.2.5.5.1 **NOTE:** Avoid damage to thermal interface material in the following step.

6.2.5.6 Install 1900806-011 PSA Tray Extender in PSA Tray 2 position by carefully guiding the tongue into the slot located in PSA and connector.

6.2.5.7 Engage captivated screw on PSA Tray Extender into PSA toe cap and tighten 15 ± 5 inch-pounds torque.

6.2.5.8 Connect cable from 1900806-011 Breakout Box to connector J2 on 1900809-011 Failure Indicator Tester.

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- 6.2.5.9 Mate connector J1 to connector 45A2P1 located on rear of PSA Tray 2.
- 6.2.5.10 Set and verify all switches to normal.
- 6.2.5.11 Re-install PSA Adapter Module in front of Power Servo Assembly.
- 6.2.5.12 Connect PSA Adapter connectors to PSA Tray 1 and 3 through 10.
Torque each connector no greater than 95 + 5 inch-ounces.
- 6.2.5.13 Connect cable from connector 45A2J1 on PSA Tray 2 to PSA Adapter Module
(Tray 2 position) connector.
- 6.2.5.14 Set and verify transfer switch to MANUAL on the IMU control panel.
Place G&N VIEWER AC1 and AC2 breaker on the Right Hand Circuit Breaker
Panel to ON position.
- 6.2.5.15 Apply AGC power by placing the G&N Computer MN A and MN B breakers on
the Right Hand Circuit Breaker Panel to ON position.
- 6.2.5.16 Close the IMU HTR MN A and MN B circuit breakers on the Right Hand
Circuit Breaker Panel (breakers pushed in).
- 6.2.5.17 Record the time in which the IMU HTR power was applied.
- 6.2.5.18 Insert the following into LEB DSKY:
Insert VERB 21, NOUN 02 and ENTER
Insert 00041 and ENTER
Insert 00000 and ENTER
- 6.2.5.19 Insert VERB 36 into K148 and press ENTER pushbutton. Press ERROR RESET
pushbutton to clear computer alarms. All alarms shall clear.
- 6.2.5.20 Verify that all switches on the Failure Indicator Tester are in the OFF position.
- 6.2.5.21 Place G&N IMU MN A and MN B breakers on the Right Hand Circuit Breaker panel
to ON position. Immediately press COARS ALIGN pushbutton on IMU
Annunciator to extinguish. Verify that GIMBAL LOCK lamp is lighted.
- 6.2.5.22 Verify that +28 VDC Operate CG 1503 lamp is lighted on Event Module.

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- 6.2.5.23 Observe CRT and verify that IRIG and PIPA temperature indication and G&N system power supply indications are not flashing.
- 6.2.5.24 Place the CAUT and WARN COMP UNIT MN A and MN B breakers on the Left Hand Circuit Breaker Panel No. 25 to ON position.
- 6.2.5.25 On the MDC Panel No. 11, Place the CAUTION/WARNING switch to C/M position and PWR switch to 1 position.
- 6.2.5.26 Press ERROR RESET pushbutton to clear computer alarms. All alarms shall clear.
- 6.2.5.27 Set and verify the TRANSFER switch to COMPUTER on the IMU CONTROL panel.
- 6.2.5.28 Insert and verify VERB 41, NOUN 20 into K148. Press ENTER pushbutton.
- 6.2.5.29 Insert and verify +00000 into K148 three times, pressing ENTER pushbutton after each insertion. Wait 60 seconds before proceeding.
- 6.2.5.30 IMU Fail (CG 5001)

- 6.2.5.30.1 Momentarily set each of the following switches one at a time on the Failure Indicator Tester of PSA Tray Extender Set to TEST. Observe the fail indications as displayed on 6.2.5.30.2. Return each switch to OFF and press MASTER CAUTION lamp button on MDC Panel 3 before proceeding with the next switch.

- a. MICROSYN EXCITATION
- b. WHEEL EXCITATION
- c. IG SERVO ERROR
- d. MG SERVO ERROR
- e. OG SERVO ERROR

6.2.5.30.2	Condition Annunciator Panel	Main Display Panel	Event Module	A C E CRT	Event Record
	IMU FAIL	IMU FAIL	IMU FAIL	IMU FAIL ON	IMU FAIL
	PGNS	*G&N ERROR	*FAILURE DETECT		ERROR DETECT
	MASTER ALARM	MASTER ALARM	ERROR DETECT		

- * Function only in Night watchman Program routine. Otherwise the lamp remains lighted.

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6.2.5.31 CDU Fail (CG 5002)

6.2.5.31.1 Momentarily set each of the following switches one at a time on the Failure Indicator Tester of PSA Tray Extender Set to TEST. Observe the fail indications as displayed on 6.2.5.31.2. Return each switch to OFF and press MASTER CAUTION lamp button on MDC Panel 18 before proceeding with the next switch.

- a. ENCODER EXCITATION
- b. CDU EXCITATION
- c. IC CDU ERROR
- d. MC CDU ERROR
- e. OC CDU ERROR

6.2.5.31.2 Condition	Main		A C E	
Annunciator	Display	Event		Event
Panel	Console	Module	CRT	Recorder
CDU FAIL	CDU FAIL	CDU FAIL	CDU FAIL ON	CDU FAIL
PGNS	*G&N ERROR	*FAILURE DETECT		ERROR DETECT
MASTER	MASTER	ERROR		
ALARM	ALARM	DETECT		

* Function only in Night watchman Program routine.
Otherwise the lamp remains lighted.

6.2.5.32 PIPA FAIL (CG 5000)

6.2.5.32.1 Momentarily set each of the following switches one at a time on the Failure Indicator Tester of PSA Tray Extender Set to TEST. Observe the fail indications as displayed in 6.2.5.32.2. Return each switch to OFF and press MASTER CAUTION lamp button on MDC Panel 3 before proceeding with the next switch.

- a. X PIP ERROR
- b. Y PIP ERROR
- c. Z PIP ERROR

6.2.5.32.2 Condition	Main		A C E	
Annunciator	Display	Event		Event
Panel	Console	Module	CRT	Recorder
ACCEL FAIL	ACCEL FAIL	PIPA FAIL	PIPA FAIL ON	PIPA FAIL
PGNS	*G&N ERROR	*FAILURE DETECT		ERROR DETECT
MASTER	MASTER	ERROR		
ALARM	ALARM	DETECT		

* Function only in Night watchman Program routine. Otherwise the lamp remains lighted.

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6.2.5.33 Gimbal Lock Test

- 6.2.5.33.1 Insert and verify VERB 41, NOUN 20 into K148. Press ENTER pushbutton.
- 6.2.5.33.2 Insert and verify +00000 into K148 two times, pressing ENTER pushbutton after each insertion.
- 6.2.5.33.3 Insert and verify +05400 into K148. Press ENTER pushbutton. Wait 60 seconds.
- 6.2.5.33.4 Verify that GIMBAL LOCK lamp on Condition Annunciator panel is not lighted.
- 6.2.5.33.5 Insert and verify VERB 23, NOUN 22 into K148. Press ENTER pushbutton.
- 6.2.5.33.6 Insert and verify +06500 into K148. Press ENTER pushbutton. Wait 60 seconds.
- 6.2.5.33.7 Verify that GIMBAL LOCK lamp on Condition Annunciator panel is lighted.
- 6.2.5.33.8 Insert and verify VERB 23, NOUN 22 into K148. Press ENTER pushbutton.
- 6.2.5.33.9 Insert and verify +18000 into K148. Press ENTER pushbutton and observe that GIMBAL LOCK lamp remains lighted while IMU and CDU are driving to 180 degrees. Wait 60 seconds.
- 6.2.5.33.10 Insert and verify VERB 23, NOUN 22 into K148. Press ENTER pushbutton.
- 6.2.5.33.11 Insert and verify +29500 into K148. Press ENTER pushbutton and observe that GIMBAL LOCK lamp remains lighted while IMU and CDU are driving to 295 degrees. Wait 60 seconds.
- 6.2.5.33.12 Insert and verify VERB 23, NOUN 22 into K148. Press ENTER pushbutton.
- 6.2.5.33.13 Insert and verify +30600 into K148. Press ENTER pushbutton. Wait 60 seconds.
- 6.2.5.33.14 Verify that the GIMBAL LOCK lamp on Condition Annunciator panel is not lighted.
- 6.2.5.34 Removal of PSA Tray Extender Set
- 6.2.5.34.1 Perform 6.2.2.1 to Turn Off G&N System.

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NOTE: Ensure that the following cables, which supply heater power to the IMU are not disconnected.

- a. 1901529 W102 cable connected between 45A7J2 on PSA Tray 7 and J1 on A23-201 PSA Adapter Module.
- b. C14-462 cable connected between J2 on A23-201 PSA Adapter Module and J6 on ICTC.

- 6.2.5.34.2 On the PSA Adapter Module (A23-201) disconnect cable from connector 45A2J1 on PSA Tray 2 to PSA Adapter Module (Tray 2 position) connector.
- 6.2.5.34.3 Disconnect the ten connectors to ACE-SC Carry-on conditioning equipment.
- 6.2.5.34.4 Disconnect PSA Adapter connectors from PSA Trays (connectors 45A1J1 through 45A10J1) except 1902438 cable connected to 45A7J2 on PSA Tray 7.
- 6.2.5.34.5 Disengage the holding screws and carefully remove A23-201 away from the Power Servo Assembly until there is sufficient clearance to remove PSA Tray 2.
- 6.2.5.34.6 On the Failure Indicator Tester (1900809-011), disconnect connector J1 from connector 45A2F1 located on rear of PSA Tray 2.
- 6.2.5.34.7 Disengage captivated screws on 1900805-011 PSA Tray Extender (located in PSA Tray 2 position) from PSA Toe Cap and remove from Power Servo Assembly.
- 6.2.5.34.8 Re-install PSA Tray 2 by carefully guiding the tongue into the slot located in PSA end connector and plug into connector 56J12. Tighten the captive screw to $27.5 \pm .2.5$ inch-pounds torque.
- 6.2.5.34.9 Re-install PSA Adapter Module (A23-201) in front of PSA).
- 6.2.5.34.10 Connect PSA Adapter connectors to all PSA Tray connectors 45A1J1 through 45A10J1. Torque each connector no greater than 100 inch-ounces.
- 6.2.5.34.11 Re-connect the ten connectors from ACE-SC carry-on conditioning equipment.
- 6.2.5.34.12 Perform Turn On Procedures as specified in 6.2.2.2.

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6.2.6 G&N Operational Test

Proceed with this test if 6.2.5 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been ~~interrupted, perform~~ 6.2.2.2 Turn On Procedure.

6.2.6.1 Initial Conditions

6.2.6.1.1 Ensure that the AGC MODE switch is in the ON position.

6.2.6.1.2 Verify that TRANSFER switch on IMU CONTROL Panel is in COMPUTER position and that the AGC Mode switch is in the ON position.

6.2.6.2 Initiation

6.2.6.2.1 Insert the following sequence into Kl48.

- a) VERB 57 ENTER
- b) 00004 ENTER

6.2.6.2.2 Verify that the PROGRAM display on CRT indicates 07.

NOTE: During this portion of the test, the G&N System is exercised through its modes and the MODE lamp displays will change automatically in the following sequence: ZERO ENCODE, FINE ALIGN, ATTITUDE CONTROL, COARSE ALIGN and FINE ALIGN. If the PROGRAM display on the LEB DSKY does not change, proper mode changing is occurring.

6.2.6.2.3 After approximately 10 minutes, the value of the gravity vector in CM/SEC² shall be displayed in R1 and R2 on CRT. Record these values. Verify VERB 06, NOUN 66 are flashing near end of 10 minute period.

6.2.6.2.4 R1 is the first five digits of the gravity vector and R2 contains the last five digits. A decimal point shall be between them. The value for the gravity vector shall be $+980.00000 \pm 10.00000$ CM/SEC².

6.2.6.2.5 Enter VERB 33 into Kl48. Press the ENTER pushbutton. Verify that VERB 06 and NOUN 66 are flashing.

6.2.6.2.6 The value of the horizontal earth rate shall be displayed in R1 and R2 on CRT. Record these values.

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6.2.6.2.7 R1 is the first five digits of earth rate and R2 contains the last five digits. A decimal point shall be placed between R1 and R2. The horizontal earth rate shall be $00000.82980 \pm .20000$ ERU (Earth Rate Unit).

6.2.6.3 Test Termination

6.2.6.3.1 Enter VERB 34 into K148. Press the ENTER pushbutton.

6.2.6.3.2 Enter VERB 41, NOUN 20 into K148. Press the ENTER pushbutton.

6.2.6.3.3 Enter 00000 into K148. Press the ENTER pushbutton.

6.2.6.3.4 Enter 00000 into K148. Press the ENTER pushbutton.

6.2.6.3.5 Enter 00000 into K148. Press the ENTER pushbutton.

6.2.6.3.6 Verify COARSE ALIGN is the only Mode lamp lighted.

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6.2.7 IMU Temperature Control Test

6.2.7.1 Proceed with this test if test in 6.2.4, Operate Power On Test, has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2 before proceeding. The signal values of this test are to be recorded as displayed on the CRT. The following Measurement Numbers and Signals are inserted here as a convenience for later reference.

ITEM NO.	MEASUREMENT NO.	SIGNAL
a.	CG 2300	PIPA TEMP
b.	CG 2301	IRIG TEMP
c.	CG 2302	HEATER CURRENT
d.	CG 2303	BLOWER CURRENT
e.	CG 2304	T.C. BRIDGE SUPPLY

6.2.7.1.1 Insure that the following Ground Support Equipment (GSE), identified in 4.1, is installed and connected before proceeding with 6.2.7.2

- a. Digital Signal Conditioning and Multiplexing Unit, Model No. C14-211.
- b. G&N Signal Conditioning and Switching Matrix Unit (DTMS) Item 7.
- c. Carry-On Command Stimuli Unit (ACE-S/C Digital Test Command System DTCS) Item 1.
- d. ACE-SC Carry-On Junction Box Item 3.
- e. PSA Adapter Module Item 17.
- f. External Digital Test Command Unit Item 9.
- g. Data Interleaver System Item 10.
- h. Electrical Cable Set Item 13.

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6.2.7.2 Set the TRANSFER switch on the IMU CONTROL panel to MANUAL. Reset any AGC alarms by entering VERB 36, pressing ENTER pushbutton then pressing ERROR RESET pushbutton on LEB AGC DSKY.

6.2.7.3 Place the G&N IMU to Standby Mode by positioning the G&N IMU MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF (Breakers pulled out). Note that the IMU OPERATE discrete lamp on Event Module is not lighted.

6.2.7.4 Place the IMU TEMP MODE selector on the G&N Indicator Control Panel to AUTO OVERRIDE position.

6.2.7.5 With the IMU in the Standby Mode, wait 30 minutes and record the values of the following signals as displayed on CRT. The BLOWER CURRENT will not be on at this time (CG 2303).

Measurement No.	Signal	Requirements
a. CG 2300	PIPA TEMP	128.0°F to 135.0°F
b. CG 2301	IRIG TEMP	128.0°F to 135.0°F
c. CG 2302	HEATER CURRENT	0.75 to 1.60 AMP
d. CG 2304	T.C. BRIDGE SUPPLY	18.7 to 25.3 VDC

6.2.7.6 Place the G&N IMU to Operate Mode by setting the G&N IMU MN A and MN B breakers on the Right Hand Circuit Breaker Panel to ON position. After the IMU DELAY lamp goes out, press the COARS ALIGN pushbutton on the IMU CONTROL panel. The COARS ALIGN lamp is the only MODE lamp that is lighted. Record the time when IMU Operate power is applied.

6.2.7.7 Place the TRANSFER switch on the IMU control panel to COMPUTER.

6.2.7.8 Enter VERB 40, MOUNT 20 into K148. Press ENTER pushbutton. Wait 90 seconds.

6.2.7.9 Enter VERB 41, MOUNT 20 into K148. Press ENTER pushbutton.

6.2.7.10 Enter +00000 into K148 three times, pressing ENTER pushbutton after each entry. COARS ALIGN mode lamp on the IMU CONTROL panel shall be the only MODE lamp lighted.

6.2.7.11 Proportional Mode

6.2.7.11.1 Set the IMU TEMP MODE selector on the G&N Indicator Control Panel to PROPORTIONAL position.

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6.2.7.11.2 Thirty minutes after IMU Operate Mode, the signal values of 6.2.7.1 shall be as follows:

- a. The PIPA temperature shall be 129.0° to 131.0°F and the IRIQ temperature shall be 132.0 to 135.0°F (CG 2300, CG 2301).
- b. The Heater current shall be 0.55 to 1.41 amperes (when current is applied) (CG 2302).
- c. The Blower current shall be 0.15 to 0.55 amperes (when current is applied) (CG 2303).
- d. The Temperature Control Bridge supply shall be 18.7 to 25.3 VDC (CG 2303).

6.2.7.11.3 After two hours from time IMU MH A and MH B power was applied, the following values shall be present.

- a. The PIPA Temperature shall be 129.5 to 130.5°F and the IRIQ temperature shall be 132.5 to 136.5°F (CG 2300, CG 2301).
- b. The Heater current shall be 0.55 to 1.41 amperes (when current is applied) (CG 2302).
- c. The Blower current shall be 0.15 to 0.55 amperes (when current is applied)(CG 2303).

6.2.7.11.4 Set IMU TEMP MODE selector to AUTO OVERRIDE. Monitor at 5-minute intervals the values of signals a and b in 6.2.7.1 for 15 minutes (3 monitor periods). Record the maximum values of each signal during this time. These values shall be within those requirements listed in 6.2.7.11.4.

6.2.7.12 Backup Mode

6.2.7.12.1 Set the IMU TEMP MODE selector on the G&N Indicator Control Panel to BACKUP position. The IMU TEMP lamp on Condition Annunciator Panel will cycle on and off.

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after 60 minutes:

- a. The PIPA temperature shall be 129.5 to 133.0°F.
- b. The IRIG temperature shall be 134.5 to 137.5°F.

6.2.7.12.2 Monitor at 5 minute intervals, the values of signals a and b in 6.2.7.1. At the end of 15 minutes (3 monitor periods) record the maximum and minimum values of these signals. The values shall be within those requirements listed in 6.2.7.12.1.

6.2.7.13 Emergency Mode

6.2.7.13.1 Set the IMU TEMP MODE selector on the G&N Indicator Control Panel to EMERGENCY position. The IMU TEMP lamp on the condition annunciator panel will be on during EMERGENCY MODE.

6.2.7.13.2 After the IMU has been switched to EMERGENCY control for a minimum of one hour, the IRIG temperature shall remain within $\pm 2.0^\circ\text{F}$ of its value in 6.2.7.11.3 and PIPA temperature shall remain within $\pm 2.0^\circ\text{F}$ of its value in 6.2.7.11.4 as indicated on the CRT.

6.2.7.14 Auto Override Mode

6.2.7.14.1 Set the IMU TEMP MODE selector on the G&N Indicator Control Panel to AUTO OVERRIDE position. Wait 30 minutes. The signal values shall be as follows: Record the values.

- a. The PIPA Temperature shall be within 129.0 to 131.0°F
- and the IRIG temperature shall be within 132.0 to 135.0°F (CG 2300, CG 2301).

b. The IMU temperature shall be within 129.0 to 131.0°F (CG 2300, CG 2301).

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6.2.8 AGC Clock Frequency Test

- 6.2.8.1 Perform this test if 6.2.4, Operate Power On Test or 6.2.2.2, Power On Procedure has been completed and G&N System Operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2, Blower On Procedure before proceeding.
- 6.2.8.2 Ensure that the AGC has been operating for at least one hour before this test.
- 6.2.8.3 Ensure that the 5245L ELECTRONICS power has been applied for the length of time as required by the manufacturers' specifications.
- 6.2.8.4 Verify that the coax PIPA FREQ MON is connected between Signal Test Point and the AC Signal Input of 5245L ELECTRONIC COUNTER.
- 6.2.8.5 Set the switches on the 52452 ELECTRONIC COUNTER to the following positions:
 - 6.2.8.5.1 Set the Preset Counter to indicate 96000.
 - 6.2.8.5.2 Set TIME BASE to ms
 - 6.2.8.5.3 Set FUNCTION to TIME INTERVAL
 - 6.2.8.5.4 Set MODE to RX PERIOD
 - 6.2.8.5.5 Set SENSITIVITY to 1
- 6.2.8.6 Rotate the ACCEL MON selector switch on the PSA Adapter Module to ACE position.
- 6.2.8.7 Enter the code 1000 into R-START 4A4-A5-R147. The upper portion of the indicator shall be illuminated. Press the XEQ/SEAL pushbutton to switch the IMU 3.2 Kcpower supply on to the hardline. Voltage shall be available on the vertical input to the PIPA Scope 4A4-A1.
- 6.2.8.8 Each count cycle should last approximately 30 seconds. Adjust display time to permit recording the display on the E-PUT.
- 6.2.8.9 Repeat the counting cycle 10 times and record the results of the 10 counting cycles. Calculate the average time per cycle for the 10 counting cycles. Record the average time per cycle.
- 6.2.8.10 The average time shall be not greater than

$$\begin{array}{rcl}
 \frac{96000}{3199.9922} & = & 30.0000731 \text{ seconds, nor less than} \\
 \frac{96000}{3200.0078} & = & 29.9999269 \text{ seconds}
 \end{array}$$

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6.2.9 G&N Panel Brightness and Lamp Test

6.2.9.1 Panel Brightness Control Operation - the PANEL BRIGHTNESS thumb-wheel shall be exercised to demonstrate the capability of controlling the illumination of the following lamps:

- a. Optical Reticles
- b. Telescope Angle Readouts
- c. IMU-CDU Difference Display
- d. COARS ALIGN MODE lamp on IMU CONTROL Panel
- e. CDU Displays

6.2.9.2 Mode Indication Lamp Check - The CHECK MODE lamps pushbutton shall be depressed and cause the following MODE lamps to be illuminated:

- a. ZERO ENC
- b. COARS ALIGN
- c. FINE ALIGN
- d. CDU MAN
- e. ATT CONT
- f. ENTRY
- g. TRACKER

6.2.9.2.1 Release the CHECK MODE lamps pushbutton. All MODE lamps except COARS ALIGN lamp on the IMU CONTROL Panel shall be extinguished.

6.2.9.3 Condition indication Lamp Check. - Set CONDITION LAMP switch ON/OFF to ON position. The CHECK CONDITION lamps pushbutton shall be depressed and shall cause the following lamps to be illuminated:

- a. G&N Error
- b. COMP PWR FAIL
- c. IMU FAIL
- e. ACCEL FAIL

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- f. G&N FAIL
- g. GIMBAL LOCK
- h. IMU TEMP
- i. ZERO ENCODE
- j. IMU DELAY (This lamp will not illuminate in Systems Standby mode)
- k. MASTER WARNING
- l. MASTER CAUTION

6.2.9.3.1 Release CHECK CONDITION lamps pushbutton. All condition lamps on the Condition Annunciator Panel shall be extinguished.

6.2.9.4 AGC Display Indication - On depression of Test Alarm Switch, the proper operation of the AGC alarm circuitry will be demonstrated by the illumination of the following lamps:

- a. RUPT LOCK
- b. TC TRAP
- c. COUNTER FAIL
- d. PARITY FAIL
- e. G&N ERROR

6.2.9.4.1 Press ERROR RESET pushbutton. All alarm lamps on the AGC DSKY shall be extinguished.

6.2.9.5 Check Coolant - The CHECK COOLANT pushbutton shall be depressed and shall cause illumination of the area in which the coolant quick disconnects are contained. Verify that the quick disconnects are not leaking and the metallic areas of the quick disconnects, visible through the Port Holes, have no droplets of condensation that might drip.

6.2.9.5.1 Release CHECK COOLANT lamp pushbutton. The COOLANT lamp shall not be lighted.

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6.2.10 Optics Servo Tests

- 6.2.10.1 Proceed with this test if 6.2.4, Operate Power-On Test, has been completed, and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2, Turn-On Procedure, before proceeding.
- 6.2.10.2 Insure that the OPTICS MNA and MNB breakers on the Right Hand Circuit Breaker Panel are pushed in (ON) and that the TRANSFER switch on the IMU Control Panel is set to COMPUTER.
- 6.2.10.3 Insure that the SLAVE TELESCOPE switch on the G&N Indicator Control Panel is set to STAR LOS, the TRACKER POWER switch is set to OFF and the TRACK pushbutton is not illuminated. Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, return the selector to MANUAL.

NOTE: If the G&N System is in IMU Operate Mode, ensure that the system is in Coarse Align Mode under AGC control.

6.2.10.4 Trunnion CDU Servo Loop Check

- 6.2.10.4.1 Set the CONTROLLED SPEED switch on the G&N Indicator Control Panel to MED and the CONTROLLER MODE switch to DIRECT.
- 6.2.10.4.2 Enter the code 2019000000 into the C-START module. Press the XEQ/SEAL pushbutton to call CG 3206 TRUNNION CDU TACH OUTPUT to the high rate channel of the Analog Recorder 4A1-A03.
- 6.2.10.4.3 Set up to monitor the following signals on the Analog Recorder 4A3-A02.

CG 3104 SXT TRUN MDA INPUT INPHASE

- 6.2.10.4.4 Start the Analog Recorders at 5 mm/sec. Move and hold the OPTICS CONTROL STICK to its upper limit not longer than 10 sec. Release the control stick and stop the Analog Recorders. Record the maximum values of CG 3206, TRUNNION CDU TACH OUTPUT and CG 3104, SXT TRUN MDA INPUT INPHASE.
- 6.2.10.4.5 The maximum value of CG 3206, TRUNNION CDU TACH OUTPUT, shall be 1.05 ± 0.20 VRMS. The maximum value of CG 3104, SXT TRUN MDA INPUT INPHASE, shall be 1.25 ± 20 VRMS.
- 6.2.10.4.6 Set the CONTROLLER SPEED selector to LO.

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- 6.2.10.4.7 Set the OPTICS MODE selector to ZERO OPTICS. After ZERO ENCODER has extinguished, return the selector to MANUAL.
- 6.2.10.4.8 Repeat 6.2.10.4.4. The maximum value of CG 3206, TRUNNION CDU TACH OUTPUT, shall be 0.105 ± 0.020 VRMS. The maximum value of CG 3104, SXT SHAFT MDA INPUT IMPHASE, shall be 0.125 ± 0.021 VRMS.
- 6.2.10.5 Shaft CDU Servo Loop Check
- 6.2.10.5.1 Enter the code 2020000000 into the C-START module. Press the XEQ/SEAL pushbutton to call CG 3226, SHAFT CDU TACH OUTPUT, to the high rate channel of Analog Recorder 4A1-A03.
- 6.2.10.5.2 Set the CONTROLLER SPEED selector on the G&N Indicator Control Panel to MED.
- 6.2.10.5.3 Place the OPTICS MODE selector on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO ENCODER has extinguished, place the selector to MANUAL.
- 6.2.10.5.4 Start the Analog Recorders 4A1-A03 and 4A3-A02 at 5 mm/sec. Move and hold the OPTICS CONTROL STICK against its right limit for not longer than 10 sec. Release the control stick and stop the Analog Recorders. Record the maximum values of CG 3226, SHAFT CDU TACH OUTPUT and CG 3114, SXT SHAFT MDA INPUT IMPHASE.
- 6.2.10.5.5 The maximum value of CG 3226, SHAFT CDU TACH OUTPUT, shall be 1.05 ± 0.20 VRMS. The maximum value of CG 3114, SXT SHAFT MDA INPUT IMPHASE, shall be 1.25 ± 0.20 VRMS.
- 6.2.10.5.6 Set the CONTROLLER SPEED selector to LO.
- 6.2.10.5.7 Repeat 6.2.10.5.3 and 6.2.10.5.4. The maximum value of CG 3226, SHAFT CDU TACHOUTPUT shall be 0.105 ± 0.020 VRMS. The maximum value of CG 3114, SXT SHAFT MDA INPUT IMPHASE shall be 0.125 ± 0.021 VRMS.
- 6.2.10.6 Optics Time to Zero
- 6.2.10.6.1 Set selector on G&N Indicator Control Panel to ZERO OPTICS. Wait 90 sec. Set selector on G&N Indicator Control Panel to MANUAL.

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- 6.2.10.6.2 Set up the Analog Recorder to monitor the following signals at a chart speed of 10 mm/sec. Do not start recorder at this time.
- | | |
|--|--------------------------------------|
| a. CG 3226, SHAFT CDU TACH OUTPUT | <u>Analog Recorder</u>
4A3-A2-1-2 |
| b. CG 3206, TRUNNION CDU TACH OUTPUT | 4A3-A2-2-2 |
| c. CG 3124, SCT SHAFT TACH FEEDBACK | 4A3-A2-5-2 |
| d. CG 3134, SCT TRUNNION TACH FEEDBACK | 4A3-A2-6-2 |
- 6.2.10.6.3 Using the control stick, drive the 2X Trunnion CDU in a positive direction to 120.0XX degrees and the Shaft CDU to 270.0XX degrees.
- 6.2.10.6.4 Start the Analog Recorder and set the OPTICS MODE selector on the G&N Indicator Control Panel to ZERO OPTICS.
- 6.2.10.6.5 When all signals have reached a steady state value, set the attenuation on the Analog Recorder to the lowest usable ranges.
- 6.2.10.6.6 After 5 seconds, stop the recorder. Record the elapsed time between steady state nulls on all signals listed in 6.2.10.6.2. The elapsed time between steady state nulls shall be less than 27 sec. for signals a) and c) and less than 12 sec. for signals b) and d).
- 6.2.10.6.7 Record the level of the CG 3141 TRUNNION CDU 16X RESOLVER and CG 3211, SHAFT CDU 16X RESOLVER signals on the CRT. The absolute value of these signals shall be 0.005 VRMS.
- 6.2.10.6.8 Record the SHAFT and 2X TRUNNION CDU indications. The 2X TRUNNION and SHAFT angle readouts shall be 0.000 ± 0.006 degrees.
- 6.2.10.7 AGC Mode Indication and Control
- 6.2.10.7.1 Enter and verify VERB 16 and NOUN 55 into K148. Press the ENTER pushbutton. The AGC display R1 and R2 on the CRT shall be all zeros.
- 6.2.10.7.2 Enter and verify VERB 11 (MONITOR) and NOUN 01 (ADDRESS) into K148. Press the ENTER pushbutton.
- 6.2.10.7.3 Enter address 00007 into K148. Press the ENTER pushbutton. The AGC display on the CRT shall indicate the contents of IN3 in R1 to be X4XXX.
- 6.2.10.7.4 Set the OPTICS MODE selector on the G&N Indicator Control Panel to MANUAL. The AGC display on the CRT shall indicate contents of IN3 in R1 to be MXXX.

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- 6.2.10.7.5 Set the OPTICS MODE selector on the G&N Indicator Control Panel to COMPUTER. The AGC display of Mode Register IN3 in R1 shall indicate 3XXXX or 7XXXX on CRT.
- 6.2.10.7.6 Enter the following sequence into the K148 and verify:
- a. VERB 21, NOUN 01, ENTER
 - b. 00723, ENTER
 - c. 40000, ENTER
 - d. VERB 41, NOUN 55, ENTER
 - e. +03000, ENTER
 - f. +15000, ENTER
- 6.2.10.7.7 Verify that the SHAFT and the 2X TRUNNION CDU move to 30.0 degrees.
- 6.2.10.7.8 Enter the following sequence into the K148:
- a. VERB 21, NOUN 01, ENTER
 - b. 00744 ENTER
- 6.2.10.7.9 Verify that the SHAFT and 2X TRUNNION CDU readouts move to 0.000 ± 0.006 degrees and stop.
- 6.2.10.7.10 Enter and verify VERB 16, NOUN 55 into K148. Press ENTER pushbutton. The AGC display of Registers R1 and R2 on the CRT shall be all zeros.
- 6.2.10.7.11 Set the OPTICS MODE selector on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, return selector to MANUAL.
- 6.2.11 Optics Slew Rate Test
- 6.2.11.1 Proceed with this test if 6.2.4, Operate Power-On Test, has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2, Turn-On Procedure, before proceeding.
- 6.2.11.2 Insure that the OPTICS MNA and MNB breakers on the Right Hand Circuit Breaker Panel are pushed in (ON) and that the TRANSFER switch on the IMU Control Panel is set to COMPUTER, and that the OPTICS MODE switch is set to DIRECT.
- 6.2.11.3 Verify that the G&N System is in the Coarse Align Mode under AGC control. COARSE ALIGN MODE lamp is the only MODE lamp that is lighted.
- 6.2.11.4 Slew Rate - High Speed
- 6.2.11.4.1 Set the CONTROLLER SPEED switch on the G&N Indicator Control Panel to HI.

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6.2.11.4.2 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lamp extinguishes, return OPTICS MODE selector to MANUAL position.

6.2.11.4.3 Record the SHAFT CDU and 2X TURNION CDU indications. The optics CDU readout shall be 00.000 ± 0.006 degrees.

NOTE: Read and understand section 6.2.11.4.4 before proceeding. Do not hold control stick at upper limit for more than ten seconds. Clear any indications on DSKY with "ERROR RESET" or "KEY RELEASE".

6.2.11.4.4 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Push the control stick to its upper limit. Two seconds later press the "MARK" pushbutton. Approximately five seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick. Verify KEY RLSE is lighted and press KEY RISE on LEB DSKY panel. Immediately record the displays in R1, R2, and R3. In a few seconds (approximately 10 seconds), the displays in R1, R2, and R3 change; record the second displays in R1, R2 and R3.

NOTE: The R1, R2, and R3 displays when the "KEY RLSE" pushbutton is pressed are as follows:
R1 is Shaft Angle as 000.00 ± 000.10 degrees
R2 is Trunnion LOS Angle as $xx.xxx$ degrees
R3 is time as $xxx.xx$ seconds

NOTE: If R1 is not within $\pm .10$ repeat 6.2.11.4.4.

6.2.11.4.5 Compute the respective differences between the R2 and R3 displays recorded in 6.2.11.4.4 as Δ Trun, and Δ Time.

6.2.11.4.6 Compute and record the Trunnion slew rate as the ratio degrees/second.

$$\frac{\Delta \text{ Trun}}{\Delta \text{ Time}}$$

6.2.11.4.7 The Trunnion slew rate shall be 9.0 ± 1.8 degrees/second.

6.2.11.4.8 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lamp is extinguished, return selector to MANUAL position.

6.2.11.4.9 Record the SHAFT CDU and 2X TURNION CDU indications. The Optics CDU readout shall be 000.000 ± 0.006 degrees.

NOTE: Read and understand section 6.2.11.4.10 before proceeding. Do not hold control stick at right limit for more than ten seconds.

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6.2.11.4.10 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Push the control stick to its right limit. Two seconds later press the "MARK" pushbutton. Approximately five seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick. Verify KEY RELEASE is displayed, press KEY RELEASE. IMMEDIATELY record the displays in R1, R2, and R3. In a few seconds (approximately 10 seconds), the displays in R1, R2 and R3 change; record the second displays in R1, R2 and R3.

NOTE: The R1, R2, and R3 displays are as follows:

R1 is Shaft Angle as xxx.xx degrees

R2 is Trunnion LOS Angle as xx.xxx degrees

R3 is time as xxx.xx seconds

NOTE: If R2 is not within 00.000 \pm .100 repeat 6.2.11.4.10.

6.2.11.4.11 Compute the respective differences between the R1 and R3 displays recorded in 6.2.11.4.10 as Δ Shaft and Δ Time.

6.2.11.4.12 Compute and record the Shaft slew rate as the ratio degrees/second.

$$\frac{\Delta \text{ Shaft}}{\Delta \text{ Time}}$$

6.2.11.4.13 The Shaft slew rate shall be 17.0 \pm 3.4 degrees/second.

6.2.11.5 Slew Rate - Medium Speed

6.2.11.5.1 Set up Analog Recorders to measure the following signals at the location specified:

- | | |
|-------------------------------------|------------|
| a. CG 3141 TRUN CDU 16X RES ERROR | 4A1-A3-7-0 |
| b. CG 3120 SXT TRUN 1X RES ERROR | 4A1-A2-8-0 |
| c. CG 3130 SCT SHAFT 1/2X RES ERROR | 4A3-A2-2-3 |
| d. CG 3211 SHAFT CDU 16X RES ERROR | 4A3-A2-8-2 |

6.2.11.5.2 Set the CONTROLLER SPEED switch on G&N Indicator Control Panel to MED.

6.2.11.5.3 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lamp extinguishes, return OPTICS MODE selector to MANUAL position.

6.2.11.5.4 Record the SHAFT CDU and 2X TRUNNION CDU indications. The optics CDU readout shall be 000.000 \pm 0.006 degrees.

NOTE: Read and understand section 6.2.11.5.5 before proceeding. Do not hold control stick at upper limit for more than twenty seconds.

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6.2.11.5.5 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Start Analog Recorder chart drive at 5 mm/sec. Push the control stick to its upper limit. Two seconds later press the "MARK" pushbutton. Approximately ten seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick and stop the Analog Recorder. Verify KEY RLSE is lighted and press KEY RLSE on LEB DSKY panel. Immediately record the displays in R1, R2 and R3. In a few seconds (approximately 10 seconds), the displays in R1, R2 and R3 change; record the second displays in R1, R2 and R3.

6.2.11.5.6 Record the value of signals specified in 6.2.11.5.1.

CG 3120 SCT TRUN LX RES ERROR shall be less than 0.200 VRMS

NOTE: The R1, R2, and R3 displays when the KEY RLSE pushbutton is pressed are as follows:
R1 is Shaft Angle as 000.00 \pm 000.10 degrees
R2 is Trunnion LOS Angle as xx.xxx degrees
R3 is time as xxx.xx seconds

NOTE: If R1 is not within \pm .10 repeat 6.2.12.5.5.

6.2.11.5.7 Compute the respective differences between the R2 and R3 displays recorded in 6.2.12.5.5 as Δ Trun, and Δ Time.

6.2.11.5.8 Compute and record the Trunnion slew rate as the ratio degrees/second.

$$\frac{\Delta \text{ Trun}}{\Delta \text{ Time}}$$

6.2.11.5.9 The Trunnion slew rate shall be 1.0 ± 0.2 degrees/second.

6.2.11.5.10 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lamp is extinguished, return selector to MANUAL position.

6.2.11.5.11 Record the SHAFT CDU and 2X TRUNNION CDU indications. The Optics CDU readout shall be 000.000 ± 0.006 degrees.

NOTE: Read and understand section 6.2.11.5.12 before proceeding. Do not hold control stick at right limit for more than ten seconds.

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6.2.11.5.12 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Start Analog Recorder chart drive at 5 mm/sec. Push the control stick to its right limit. Two seconds later press the "MARK" pushbutton. Approximately ten seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick and stop the Analog Recorder. Verify KEY RELEASE is displayed, press KEY RELEASE. IMMEDIATELY record the displays in R1, R2 and R3. In a few seconds (approximately 10 seconds), the displays in R1, R2 and R3 change; record the second displays in R1, R2 and R3.

6.2.11.5.13 Record the value of signal e specified in 6.2.11.5.1.

e) CG 3130 SCT SHAFT LY RES ERROR shall be less than 0.200 VRMS

NOTE: The R1, R2 and R3 displays are as follows:
R1 is Shaft Angle as xxx.xx degrees
R2 is Trunnion LOS Angle as xx.xxx degrees
R3 is Time as xxx.xx seconds

NOTE: If R2 is not within 00.000 \pm .100, repeat 6.2.11.5.12.

6.2.11.5.14 Compute the respective differences between the R1, and R3 displays recorded in 6.2.11.5.12 as Δ Shaft, and Δ Time.

6.2.11.5.15 Compute and record the Shaft slew rate as the ratio degrees/second.

$$\frac{\Delta \text{ Shaft}}{\Delta \text{ Time}}$$

6.2.11.5.16 The Shaft slew rate shall be 2.0 \pm 0.2 degrees/second.

6.2.11.6 Slew Rate - Low Speed

6.2.11.6.1 Set the CONTROLLER SPEED switch on G&N Indicator Control Panel to LO.

6.2.11.6.2 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lamp extinguishes, return OPTICS MODE selector to MANUAL position.

6.2.11.6.3 Record the SHAFT CDU and 2X TRUNNION CDU indications. The optics CDU readout shall be 000.000 \pm 0.006 degrees.

NOTE: Read and understand section 6.2.11.6.4 before proceeding. Do not hold control stick at upper limit for more than thirty seconds.

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6.2.11.6.4 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Start Analog Recorder chart drive at 5 mm/sec. Push the control stick to its upper limit. Two seconds later press the "MARK" pushbutton. Approximately ten seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick and stop the Analog Recorder. Verify KEY RLSE is lighted and press KEY RLSE on LEB DSKY panel. Immediately record the displays in R1, R2, and R3. In a few seconds (approximately 10 seconds), the displays in R1, R2 and R3 change; record the second displays in R1, R2 and R3.

6.2.11.6.5 Record the value of signal b) specified in 6.2.12.5.1 of the Medium Speed Test.

b) CG 3120 SGT TRUN 1X RES ERROR shall be less than 0.200 VRMS

NOTE: The R1, R2 and R3 displays when the "MARK" pushbutton is pressed are as follows:
R1 is Shaft Angle as 000.00 + 000.10 degrees
R2 is Trunnion LOS Angle as xx.xxx degrees
R3 is Time as xxx.xx seconds

NOTE: If R1 is not within $\pm .10$, repeat 6.2.12.6.4

6.2.11.6.6 Compute the respective differences between the R2 and R3 displays recorded in 6.2.11.6.4 as Δ Trun, and Δ Time.

6.2.11.6.7 Compute and record the Trunnion slew rate as the ratio degrees/second.

$$\frac{\Delta \text{ Trun}}{\Delta \text{ Time}}$$

6.2.11.6.8 The Trunnion slew rate shall be 0.1 ± 0.02 degrees/second.

6.2.11.6.9 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lamp is extinguished return selector to MANUAL position.

6.2.11.6.10 Record the SHAFT CDU and 2X TRUNNION CDU indications. The Optics CDU readout shall be 000.000 ± 0.006 degrees.

NOTE: Read and understand section 6.2.11.6.11 before proceeding. Do not hold control stick at right limit for more than ten seconds.

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6.2.11.6.11 Insert VERB 06, MOUN 56 and press ENTER on DSKY. Start Analog Recorder chart drive at 5 mm/sec. Push the control stick to its right limit. Two seconds later press the "MARK" pushbutton. Approximately ten seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick and stop the Analog Recorder. Verify KEY RLSE is displayed. Press KEY RLSE. IMMEDIATELY record the displays in R1, R2 and R3. In a few seconds (approximately 10 seconds), the displays in R1, R2 and R3 change; record the second displays in R1, R2 and R3.

6.2.11.6.12 Record the value of signals c) and d) specified in 6.2.11.5.1 of the Medium Speed test.

b) CG 3130 SCT SHAFT LX RES ERROR shall be less than 0.200 VRMS

NOTE: The R1, R2 and R3 displays are as follows:
R1 is Shaft Angle as xxx.xx degrees
R2 is Trunnion LOS Angle as xx.xxx degrees
R3 is Time as xxx.xx seconds

NOTE: If R2 is not within 00.000 \pm .10, repeat 6.2.11.6.11.

6.2.11.6.13 Compute the respective differences between the R1 and R3 displays recorded in 6.2.11.6.11 as Δ Shaft, and Δ Time.

6.2.11.6.14 Compute and record the Shaft slew rate as the ratio degrees/second.

$$\frac{\Delta \text{ Shaft}}{\Delta \text{ Time}}$$

6.2.11.6.15 The Shaft slew rate shall be 0.2 \pm 0.04 degrees/second.

6.2.11.7 AOC Optics Slewling

6.2.11.7.1 Set the OPTICS MODE selector to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, set the selector to COMPUTER.

6.2.11.7.2 Set up the Analog Recorder 4A3-A2 to monitor the following signals:

a. CG 3104, SXT TRUNNION TACH FEEDBACK	4A3-A2-1-3
b. CG 3115, SXT SHAFT TACH FEEDBACK	4A3-A2-7-1
c. CG 3134, SCT TRUNNION TACH FEEDBACK	4A3-A2-4-3
d. CG 3124, SCT SHAFT TACH FEEDBACK	4A3-A2-3-2

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6.2.11.7.3 Enter the following sequence into K148:

- a. VERB 41, NOUN 55, ENTER
- b. +27000, ENTER
- c. +60000, ENTER
- d. VERB 21, NOUN 01, ENTER
- e. 00723, ENTER
- f. 40000 (do not enter)

6.2.11.7.4 Start the Analog Recorder at 10 mm/sec and depress the ENTER button on the K148. Wait until the transients have died out and stop the Analog Recorder. Record the elapsed time for each signal in 6.2.11.7.2 to reach its final value. In all cases, the elapsed time for the signals in 6.2.11.7.2 shall be less than 50 sec.

6.2.11.7.5 Record the SHAFT and 2X TRUNNION CDU dial indications. The SHAFT CDU shall read 270.0 ± 0.022 degrees. The 2X TRUNNION CDU shall read 120.00 ± 0.01 degrees.

6.2.11.7.6 Place the OPTICS MODE selector to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, return the selector to MANUAL.

6.2.11.7.7 Verify that G&N System is in the Coarse Align Mode under Computer control.

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6.2.12 Optics Coordinate Transformation Control Test

- 6.2.12.1 Proceed with this test if 6.2.4, Operate Power On Test, or 6.2.2.2, Turn On Procedure, has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2, Turn On Procedure, before proceeding with this test.
- 6.2.12.2 Insure that the OPTICS MNA and MNB breakers on the Right Hand Circuit Breaker Panel are pushed on (ON) and that the G&N System is in the Coarse Align mode. The COARS ALIGN lamp on the IMU CONTROL Panel shall be the only MODE lamp illuminated.
- 6.2.12.3 Verify that the TRANSFER switch on the IMU CONTROL Panel is set to COMPUTER.
- 6.2.12.4 Set the OPTICS MODE selector on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, return the selector to MANUAL.
- 6.2.12.5 Set the CONTROLLER MODE switch on the G&N Indicator Control Panel to DIRECT.
- 6.2.12.6 Optics Coordinate Transformation Control Test
- 6.2.12.6.1 Using the control stick at desired speed, set SHAFT ANGLE CDU to 225.000 degrees and 2X TRUNNION CDU to 10.000 degrees. Set CONTROLLER SPEED to LO to minimize drift.
- 6.2.12.6.2 Sight through the SCT eyepiece. Move the movable target so it is centered on the SCT reticle pattern. Maintain 2X TRUNNION CDU at 10.000 ± 0.200 degrees and SHAFT ANGLE CDU at 225.000 ± 0.200 degrees by manipulating control stick.
- 6.2.12.6.3 Set the switches on the G&N Indicator Control Panel as follows:
- a. CONTROLLER MODE to RESOLVED
 - b. CONTROLLER SPEED to MED

NOTE: The following step will require coordination between the K START and Command Module operators. Each should read and thoroughly understand this step before proceeding.

- 6.2.12.6.4 Simultaneously sight through the SCT eyepiece, quickly displace the CONTROL STICK 45 degrees in the upper right hand quadrant and press the MARK pushbutton. Record the CRT indication of R3. Observe the viewed object and when it leaves the SCT upper rightfield of view press the MARK pushbutton. Record the CRT indications of R1 and R3. R1 indication shall be 225 ± 10 degrees and the difference of the R3 indications shall be 30 ± 6 seconds.

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6.2.12.6.5 Set the CONTROLLER MODE switch on the G&N Indicator Control Panel to DIRECT.

6.2.12.6.6 Set the OPTICS MODE selector on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, return the selector to MANUAL.

6.2.12.7 Mark Pushbutton Test

6.2.12.7.1 Using the CONTROL STICK at desired controller speed, set the SHAFT CDI to 50.000 ± 0.010 degrees and 2X TRUNNION CDI to 30.000 ± 0.010 degrees.

6.2.12.7.2 Press the MARK pushbutton on G&N Indicator Control Panel.

6.2.12.7.3 Observe VERB 06 NOUN 56 displayed on CRT.

6.2.12.7.4 The OPTX counter in R1 shall indicate 06000 ± 00003 . Record the counter from CRT.

6.2.12.7.5 The OPTX counter in R2 shall indicate 15000 ± 00014 . Record the counter from CRT.

6.2.12.7.6 Set the OPTICS MODE selector on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, return the selector to MANUAL.

6.2.13 Optics Positional Accuracy Test

6.2.13.1 Proceed with this test if 6.2.4, Operate Power on Test, or 6.2.2.2, Turn on Procedure, has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.1, Turn On Procedure, before proceeding.

NOTE: This test requires the use of G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT StLOS in accordance with "Alignment of Optical Target GSE on Spacecraft Process Specification No. MA 0201-5036."

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Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.

Insure that qualified personnel are available outside the Spacecraft to take observations and position the retro-reflecting prism.

- 6.2.13.2 G&N System shall be in COARSE ALIGN MODE under AGC control. Optics operate power shall be applied by pushing in the OPTICS MNA and MNB Breakers on the Right Hand Circuit Breaker Panel.
- 6.2.13.3 Optics controls on the G&N Indicator Control Panel shall be set as follows:
- a. CONTROLLER SPEED - MED
 - b. CONTROLLER MODE - DIRECT
 - c. SLAVE TELESCOPE - STAR LOS
 - d. OPTICS MODE - ZERO OPTICS
- 6.2.13.4 Resolution Checks
- 6.2.13.4.1 After ZERO ENCODER lamp has extinguished, set OPTICS MODE switch to MANUAL position.
- 6.2.13.4.2 Sight on the 5 inch Autocollimator, through the SXT eyepiece. Using the CONTROL STICK to drive the SXT to the approximate position, adjust the TRUNNION and SHAFT ANGLE to view the autocollimator resolution pattern at the center of the field of view.
- 6.2.13.4.3 Note that the 5 inch autocollimator resolution pattern contains a series of lines of different thickness and width. Each set of lines is marked with a numeral (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space in seconds of arc. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines.
- 6.2.13.4.3.1 The SXT resolution shall be at least 10 arc seconds at center of field of view.

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6.2.13.4.4 Sight through the SCT eyepiece and align the SCT with the control stick until the SCT resolution chart is centered in the field of view, using the SCT and the resolution chart. Record the number of the lowest numbered set distinctly seen with the SCT. The SCT shall demonstrate a resolution of at least 3 arc minutes at center of field of view.

6.2.13.5 Slave Telescope Mode Checks

6.2.13.5.1 Set OPTICS MODE selector to ZERO OPTICS. After the ZERO ENCODER lamp is extinguished, return selector to MANUAL position. Verify SLAVE TELESCOPE switch is in the STAR LOS position.

6.2.13.5.2 Record SCT Shaft and Trunnion Angles on the TPAC and the SHAFT and 2X TRUNNION CDU indications. The difference between TPAC angles and corresponding CDU angles shall be less than 0.5 degrees.

NOTE: TPAC TRUNNION angle counter reading indicates LOS angle and 2X TRUNNION CDU angle reading indicates 2X LOS angle. The 2X TRUNNION CDU indication must be divided by two before subtracting from SCT TRUNNION display.

6.2.13.5.3 Using Control Stick, drive 2X TRUNNION and SHAFT CDU's to 35.500 degrees. Record TPAC shaft angle (35.5 ± 0.5 degrees) and Trunnion angle (17.75 ± 0.25 degrees) on the TPAC.

6.2.13.5.4 Repeat 6.2.13.5.1

6.2.13.5.5 Set SLAVE TELESCOPE Switch to LANDMARK LOS 0°.

6.2.13.5.6 Remove the plug from the base of SXT eyepiece. Install the Adapter Assembly and Portable Light Assembly in this location. Turn on the light.

NOTE: It will be necessary for the optics operator to communicate with the personnel outside the Spacecraft handling the optical GSE (Retroreflecting Prism, Autocollimator, etc.) through 6.2.13.8.2.

If needed to reduce external light, obtain, place, and secure a photographer's hood over the optics head and the retroreflecting prism.

6.2.13.5.7 Sight through the SCT eyepiece and give direction for positioning the Retroreflecting Prism, Model No. A23-200, to span between the SXT StLOS and SCT LOS, so that the illumination from the backlight filament is clearly visible at the center of the field. The prism must be held in this position until after completion of Step 6.2.13.5.12.

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- 6.2.13.5.8 Remove the Portable Light from the adapter on the SKT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SKT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SKT reticle. Adjust the 2X TRUNNION CDU with OPTICS CONTROL Stick to bring the SCT horizontal reticle line into coincidence with the SKT horizontal reticle line. Record the 2X TRUNNION CDU angle. The difference between this angle and the corresponding angle recorded in Step 6.2.13.5.2 shall be less than $\pm .440$ degrees.
- 6.2.13.5.9 Replace the Portable Light in the adapter in the SKT eyepiece.
- 6.2.13.5.10 Readjust the 2X TRUNNION CDU to obtain the values $\pm .002$ degrees recorded in Step 6.2.13.5.2 (at the zero optics position). Then set SLAVE TELESCOPE Switch to STAR LOS.
- 6.2.13.5.11 To temporarily disable the electrical drive to the SCT TRUNNION, carefully unscrew the SCT TRUNNION Manual Drive item until it just releases from the panel. Do not rotate further, as this would displace the SCT LOS from the desired reference position.
- 6.2.13.5.12 Verify that the Retroreflecting Prism is still in the desired position as in Step 6.2.13.5.7 by sighting into the SCT eyepiece. Then remove the Portable Light from the adapter and again direct the light beam into the SCT eyepiece while sighting into the SKT eyepiece as in Step 6.2.13.5.8. Again observe the positions of the SCT and SKT reticles and adjust the 2X TRUNNION CDU with CONTROLLER Stick to bring the SCT horizontal reticle line into coincidence with the SKT horizontal reticle line. Record the 2X TRUNNION CDU angle. The difference between this angle and the corresponding angle recorded in Step 6.2.13.5.2 shall be less than $\pm .440$ degrees. Replace the Portable Light in the adapter.
- 6.2.13.5.13 Replace the SCT TRUNNION Manual Adjust drive in the panel.
- 6.2.13.5.14 Use the Control Stick to drive the 2X TRUNNION CDU to 50.000 ± 0.005 degrees.
- 6.2.13.5.15 Set SLAVE TELESCOPE Switch to OFFSET 25° . After 30 seconds has elapsed from time of switch operation, record TPAC TRUNNION angle and CDU 2X TRUNNION angle. The difference shall be $25^\circ \pm 0.5$ degrees. Also record CDU SHAFT angle.
- 6.2.13.5.16 To temporarily disable the electrical drive to the SCT TRUNNION and SCT SHAFT, carefully unscrew the SCT TRUNNION and SCT SHAFT Manual Drive item until they just release from the panel. Do not rotate further as this would displace the SCT LOS from the desired reference position.

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- 6.2.13.5.17 For this step it is necessary to reposition the Retroreflecting Prism so that it is inclined at an angle 25° downward in such a position as to span the SCT LOS and the SXT StLOS. After the prism has been moved to the approximate position described above, again sight into the SCT eyepiece and give direction as necessary to adjust the prism position so that the illumination from the backlight filament is again visible at the center of the field. Then remove the Portable Light Assembly (from the SXT eyepiece adapter) and sight through the SXT eyepiece while directing the light assembly into the SCT eyepiece. Again observe the comparison of SCT and SXT reticles. Adjust the 2X TRUNNION CDU and the SHAFT CDU with OPTICS CONTROLLER Stick to bring the two reticle patterns into coincidence. Record the 2XTRUNNION CDU angle and the SHAFT CDU angle. The difference between each of these two angles and the corresponding values recorded in Step 6.2.13.5.5 shall be less than $\pm .440$ degrees.
- 6.2.13.5.18 Replace Portable Light Assembly in the adapter. Set SLAVE TELESCOPE switch to STAR LOS. Set OPTICS MODE selector to ZERO OPTICS. After the ZERO ENCODER lamp is extinguished, return selector to MANUAL position. Verify SLAVE TELESCOPE Switch is in the STAR LOS position. Remove hood (if used) and Retroreflecting Prism.
- 6.2.13.6 Sextant Parallelism Tests
- 6.2.13.6.1 Using Control Stick (with CONTROLLER SPEED switch HI), drive SXT StLOS to 30.000 ± 2.0 degrees as indicated on the 2X TRUNNION CDU.
- 6.2.13.6.2 Insure that SHAFT CDU readout indicates 000.000 ± 0.006 degrees. Use Control Stick to correct it, if required.
- 6.2.13.6.3 Sight through the autocollimator eyepiece and superimpose the sextant horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.
- 6.2.13.6.4 Repeat 6.2.13.6.3 twice and record the average of the three autocollimator readings.
- 6.2.13.6.5 Set OPTICS MODE selector to ZERO OPTICS. Return selector to MANUAL position after ZERO ENCODER lamp is extinguished on the Condition Annunciator Panel.. Insure that 2X TRUNNION CDU readout indicates 000.000 ± 0.002 degrees, and SHAFT ANGLE CDU indicates $000.000 \pm .006$ degrees. Correct if necessary. Record 2X TRUNNION and SHAFT CDU indications.

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- 6.2.13.6.6 Again sight through 5 inch autocollimator eyepiece and adjust the horizontal filar (not autocollimator) to bring StLOS horizontal reticle line and filar horizontal image to coincidence. Record the average of three filar position indications. This reading shall not differ from that obtained in 6.2.13.6.4 by more than 15 arc seconds.
- 6.2.13.7 Shaft and Trunnion Positional Accuracy Checks
- 6.2.13.7.1 Set OPTICS MODE selector to ZERO OPTICS. Return selector to MANUAL position after ZERO ENCODER lamp is extinguished.
- 6.2.13.7.2 Enter VERB 41, NOUN 55 into the K- 148. Press ENTER pushbutton. The VERB-NOUN display shall indicate 21-57 flashing on CRT.
- 6.2.13.7.3 Enter 00400 into the K- 148. Press ENTER pushbutton. Enter 00200 into the K- 148. Press ENTER pushbutton. The VERB-NOUN display on CRT shall stop flashing.
- 6.2.13.7.4 Enter VERB 14, NOUN 55 into K- 148. Press ENTER pushbutton. Record the value of the SHAFT and TRUNNION CDU counters in R1 and R2 on CRT.
- 6.2.13.7.5 Record SHAFT and 2X TRUNNION CDU indications.
- 6.2.13.7.6 Set OPTICS MODE selector to ZERO OPTICS. After ZERO ENCODER lamp is extinguished, return selector to MANUAL.
- 6.2.13.7.7 Using Optics Hand Controller, set SHAFT and 2X TRUNNION CDU's to the values recorded in 6.2.13.1.8.
- 6.2.13.7.8 Record the value of the SHAFT and TRUNNION CDU counters in R1 and R2 on CRT.
- 6.2.13.7.8.1 The values of 6.2.13.7.8 shall differ from those of 6.2.13.7.4 by no more than ± 00005 .
- NOTE: Read and understand 6.2.14.7.11 before proceeding.
- 6.2.13.7.9 Sight through the SXT. Using Control Stick, align the SXT StLOS with optical target No. 1 (approximately 2X TRUNNION 106.650 degrees, SHAFT ANGLE 118.500 degrees) on the G&N Installation Qualification Fixture Model No. A23-071. At the instant of coincidence, simultaneously press "MARK" pushbutton and read the SHAFT TRUNNION CDU indication.
- NOTE: VERB 06, NOUN 56 shall appear on DSKY indicating optical CDU and time displays.
- 6.2.13.7.10 Record the SHAFT angle as indicated on R1 and TRUNNION angle as indicated on R2 of LEB DSKY. Record the SHAFT and 2X TRUNNION CDU indication.

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- 6.2.13.7.10.1 Repeat 6.2.13.7.9 through 6.2.13.7.10 two more times. If two of the specific recorded angles are equal, record this angle. If all three of the recorded angles are different, select the value that is between the higher and lower values.
- 6.2.13.7.11 Sight through the SXT. Using Control Stick, align the SXT StLOS with Optical Target No. 2 (approximately 2X TRUNNION 106.650 degrees and SHAFT ANGLE 241.500 degrees) on A23-071. At the instant of coincidence, simultaneously press "MARK" pushbutton and read SHAFT and TRUNNION CDU.
- NOTE: VERB 06, NOUN 56 shall appear on DSKY.
- 6.2.13.7.12 Record the SHAFT angle as indicated on R1 and TRUNNION angle as indicated on R2 of LEB DSKY. Record the SHAFT and 2X TRUNNION CDU indication.
- 6.2.13.7.12.1 Repeat 6.2.13.7.11 through 6.2.13.7.12 two more times. If two of the specific recorded angles are equal, record this angle. If all three of the recorded angles are different, select the value that is between the higher and lower values.
- 6.2.13.7.13 Set OPTICS MODE selector to ZERO OPTICS. After the ZERO ENCODER lamp is extinguished, set selector to COMPUTER position.
- 6.2.13.7.14 Enter VERB 41, NOUN 55 into K- 148. Press ENTER pushbutton. VERB-NOUN display shall flash 21-57.
- 6.2.13.7.15 Enter the value recorded from R1 in 6.2.13.7.10.1 into K- 148. Press ENTER pushbutton.
- 6.2.13.7.16 Enter the value recorded from R2 in 6.2.13.7.10.1 into K- 148. Press ENTER pushbutton.
- 6.2.13.7.17 Sight through the SXT. The StLOS should be centered on Optical Target No. 1 on A23-071. Record SHAFT and 2X TRUNNION CDU indications.
- 6.2.13.7.18 Enter VERB 41, NOUN 55 into K- 148. Press ENTER pushbutton. VERB-NOUN displays shall flash 21-57.
- 6.2.13.7.19 Enter the value recorded from R1 in 6.2.13.7.12.1 into the K- 148. Press ENTER pushbutton.
- 6.2.13.7.20 Enter the value recorded from R2 in 6.2.13.7.12.1 into the K- 148. Press ENTER pushbutton.
- 6.2.13.7.21 Sight through the SXT. The StLOS should be centered on Optical Target No. 2 on A23-071. Record SHAFT and 2X TRUNNION CDU indications.

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- 6.2.13.7.22 The difference between the SHAFT CDU indications from 6.2.13.7.10.1 and 6.2.13.7.17 shall not exceed 0.025 degrees. Record this difference.
- 6.2.13.7.22.1 The difference the 2X TRUNNION CDU indications from 6.2.13.7.10.1 and 6.2.13.7.17 shall not exceed 0.025 degrees. Record this difference.
- 6.2.13.7.22.2 The difference between the SHAFT CDU indications from 6.2.13.7.12.1 and 6.2.13.7.21 shall not exceed 0.025 degrees. Record this difference.
- 6.2.13.7.22.3 The difference between the 2X TRUNNION CDU indications from 6.2.13.7.12.1 and 6.2.13.7.21 shall not exceed 0.025 degrees. Record this difference.
- 6.2.13.8 SXT StLOS-LLOS Parallelism Test, 90 Degree Position
- 6.2.13.8.1 Set the OPTICS MODE selector to ZERO OPTICS position. After the ZERO ENCODER lamp is extinguished, set selector to MANUAL position.
- 6.2.13.8.2 Set CONTROLLER SPEED to MEDIUM. Set OPTICS HOLD to OFF. Using Control Stick, drive the SXT TRUNNION axis until the 2X TRUNNION CDU indicates 175 ± 5 degrees.
- 6.2.13.8.3 Set CONTROLLER SPEED to LO and drive the 2X TRUNNION CDU until it indicates 180.000 degrees. Insure that the SHAFT CDU indicates 0.000 ± 0.006 degrees.
- 6.2.13.8.4 If necessary, cover the optics head with a photographer's hood (or any acceptable substitute) to block stray light from the sextant head.
- 6.2.13.8.5 Turn on SXT Portable Light Assembly
- 6.2.13.8.6 Sight through the SXT. Two reticle patterns shall be visible. Use the Optics Hand Controller to adjust the SXT TRUNNION axis until the two horizontal reticle line are coincident. Record the 2X TRUNNION angle.
- 6.2.13.8.6.1 The 2X TRUNNION CDU shall indicate 180.000 ± 0.020 degrees.
- 6.2.13.8.7 Remove the Portable Light Assembly and Adapter Assembly from the base of the SXT eyepiece. Replace Sextant eyepiece plug.
- 6.2.13.9 Set OPTICS MODE selector to ZERO OPTICS. After the ZERO ENCODER lamp is extinguished on the Condition Annunciator Panel, return selector to MANUAL position.
- 6.2.13.10 Verify that the SHAFT CDU and 2X TRUNNION CDU indications on the OPTICS CDU readout indicate 000.000 ± 0.006 degrees.
- 6.2.13.11 Remove OPTICS power by pulling out OPTICS MNA and MNB circuit breakers on Right Hand Circuit Breaker panel.

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6.2.14 AGC Mode Control Test

6.2.14.1 Proceed with this test if 6.2.4 Operate Power on Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2 Turn On Procedure.

6.2.14.2 Verify that the TRANSFER switch is set to COMPUTER and COARSE ALIGN is the only mode lamp lighted.

6.2.14.3 Verify that the MODE pushbutton on the IMU CONTROL panel will not effect a mode change by pressing each button not lighted. The COARS ALIGN MODE lamp shall remain lighted.

6.2.14.4 Zero Encode Mode

6.2.14.4.1 Enter VERB 25, NOUN 22 into K- 148. Press the ENTER pushbutton.

6.2.14.4.2 Enter +04000 into K- 148. Press the ENTER pushbutton.

6.2.14.4.3 Enter +04000 into K-148. Press the ENTER pushbutton.

6.2.14.4.4 Enter +04000 into K- 148. Press the ENTER pushbutton.

6.2.14.4.5 Wait 30 seconds.

NOTE: Perform 6.2.14.4.6 through 6.2.14.4.10 within 30 seconds.

6.2.14.4.6 Enter VERB 40, NOUN 20 into K- 148. Press the ENTER pushbutton.

6.2.14.4.7 Verify the K Relays on CRT indicate 001001 immediately after pushing ENTER pushbutton. Record.

6.2.14.4.8 Verify that the INNER, MIDDLE, and OUTER Gimbal CDU's indicate 000.000 ± 1.00 degrees. Record.

6.2.14.4.9 Enter VERB 15, NOUN 20 into K- 148. Press the ENTER pushbutton.

NOTE: (a) KEY RELEASE and CHECK FAIL will be lighted. Press KEY RELEASE on DSKY.

(b) CDU FAIL will momentary lighted on Condition Annunciator Panel.

6.2.14.4.10 Verify that the contents of R1, R2, and R3 on CRT indicate all zeros. Record.

6.2.14.4.11 Verify ZERO ENCODER on Condition Annunciator Panel has extinguished before proceeding.

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6.2.14.5 Coarse Align Mode

6.2.14.5.1 Enter VERB 41, NOUN 20 into K-148. Press the ENTER pushbutton.

6.2.14.5.2 Enter +00000 into K-148. Press the ENTER pushbutton.

6.2.14.5.3 Enter +00000 into K-148. Press the ENTER pushbutton.

6.2.14.5.4 Enter +00000 into K-148. Press the ENTER pushbutton. Wait 60 seconds.

NOTE: The PGNS lamp will light on the Condition Annunciator Panel. Disregard lamp indication.

6.2.14.5.5 Set up the Analog Recorders 4A1-A2 and 4A3-A2 to monitor the following signals:

	<u>Signal</u>	<u>Analog Recorder</u>
a.	CG 2110 IGA TORQUE MOTOR INPUT	4A3-A2
b.	CG 2140 MGA TORQUE MOTOR INPUT	4A3-A2
c.	CG 2170 OGA TORQUE MOTOR INPUT	4A3-A2

6.2.14.5.6 Enter (and verify) VERB 41, NOUN 20 (COURSE ALIGN) into K-148. Press ENTER pushbutton.

6.2.14.5.7 Enter +06000 into K-148 twice. Press ENTER pushbutton after each entry.

6.2.14.5.8 Start Analog Recorder 4A3-A2. Enter +06000 into K-148. Press ENTER pushbutton.

NOTE: The GIMBAL LOCK lamps on the Condition Annunciator Panel and on Event Modules may light. Disregard these lamp indications unless specifically indicated to do otherwise.

6.2.14.5.9 After the transients have died out, stop Analog Recorder 4A3-A2. Determine the time elapsed on each signal specified in 6.2.14.5.5 between the initial and final transients. Record elapsed times. The elapsed times for IGA, OGA, and MGA to drive from zero degrees to 60 degrees shall be no greater than 21 seconds.

6.2.14.5.10 Verify that the K Relays on CRT indicate 000010. Record.

6.2.14.5.11 Record IMU-CDU DIFFERENCE meter indications for the INNER, MIDDLE, and OUTER GIMBAL channels. The INNER, MIDDLE, and OUTER indicators in the IMU-CDU DIFFERENCE meter shall be 0. \pm 1.0 degrees.

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- 6.2.14.5.12 Record the indicated value of the following signals in Table VII on the CRT.

Table VII Signal Voltage Requirements

<u>Signals</u>	<u>Requirements</u>
1. CG 2206 IGA CDU IX RES ERROR	0.0 to .210 VRMS
2. CG 2236 MGA CDU IX RES ERROR	0.0 to .210 VRMS
3. CG 2266 OGA CDU IX RES ERROR	0.0 to .210 VRMS
4. INNER GIMBAL ANGLE	60 \pm 2.5 degrees
5. MIDDLE GIMBAL ANGLE	60 \pm 2.5 degrees
6. OUTER GIMBAL ANGLE	60 \pm 2.5 degrees
7. CG 2209 SCS PITCH	0.0 \pm 1.00 degrees
8. CG 2239 SCS YAW BODY AXIS	0.0 \pm 1.00 degrees
9. CG 2241 SCS YAW OFFSET AXIS	0.0 \pm 1.00 degrees
10. CG 2269 SCS ROLL BODY AXIS	0.0 \pm 1.00 degrees
11. CG 2271 SCS ROLL OFFSET AXIS	LLL to UUU degrees

6.2.14.6 Fine Align Mode

NOTE: GIMBAL LOCK may be on during the duration of FINE Align Mode test.

- 6.2.14.6.1 Enter (and verify) VERB 42 into K-148. Press ENTER pushbutton to advance G&N to the FINE ALIGN mode. The VERB-NOUN display shall indicate 21-67 flashing.
- 6.2.14.6.2 Enter +100000 three times pressing ENTER pushbutton after each entry into K-148. Press ENTER pushbutton. Verify VERB-NOUN display shall stop flashing. The FINE ALIGN MODE lamp on the IMU CONTROL Panel is the only MODE lamp that is lighted.
- 6.2.14.6.3 Record the indicated values of the following signals in Table VIII on the CRT.

Table III Voltage Requirements

<u>Signals</u>	<u>Requirements</u>
a. CG 2204 IGA CDU 16X RES ERROR	0.0 to .200 VRMS
b. CG 2234 MGA CDU 16X RES ERROR	0.0 to .200 VRMS
c. CG 2264 OGA CDU 16X RES ERROR	0.0 to .200 VRMS
d. CG 2107 OGA SERVO ERROR	0.0 to .36 VRMS
e. CG 2137 MGA SERVO ERROR	0.0 to .36 VRMS
f. CG 2167 OGA SERVO ERROR	0.0 to .36 VRMS

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- 6.2.14.6.3 (Continued) Table LLL Voltage Requirements
- | | <u>Signals</u> | <u>Requirements</u> |
|----|------------------------------|----------------------|
| g. | CG 2209 SCS PITCH | 0 \pm 1.00 degrees |
| h. | CG 2239 SCS YAW BODY AXIS | 0 \pm 1.00 degrees |
| i. | CG 2241 SCS YAS OFFSET AXIS | 0 \pm 1.00 degrees |
| j. | CG 2269 SCS ROLL BODY AXIS | 0 \pm 1.00 degrees |
| k. | CG 2271 SCS ROLL OFFSET AXIS | LLL to UUU degrees |
- 6.2.14.6.4 Record the INNER, MIDDLE, and OUTER GIMBAL CDU indications. The INNER, MIDDLE, and OUTER indicator on the IMU-CDU DIFFERENCE meter shall be 0.0 \pm 1.0 degrees.
- 6.2.14.6.5 Verify that the K-RELAYS on CRT indicate 001000.
- 6.2.14.6.6 Insert the following into LEB DSKY.
- Insert VERB 41, NOUN 20 ENTER.
 - Insert +00000, ENTER.
 - Insert +00000, ENTER.
 - Insert +00000, ENTER.
 - Wait 60 seconds.
- 6.2.14.7 Attitude Control Mode
- 6.2.14.7.1 Ensure that the SCS is in one of the non G&N modes.
- 6.2.14.7.2 Obtain G&N Overall Polarity Tape F04C0 14-K00019-00 and load the tape on TAPE READER, Console 4A4-A3-K148.
- NOTE: This tape is to be used with all SUNSPOT program assemblies to verify the phasing and installation of the G&N System into the Apollo Spacecraft. Attitude and attitude error signals, generated under AGC Control are verified as to magnitude and polarity.
- NOTE not valid for Corona Program Assembly.
- 6.2.14.7.3 Set the POWER/ON switch on the TAPE READER 4A4-A2 to ON.

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6.2.14.7.4 Perform the following steps on Console 4A4-A3 in sequence:

- a. Press the TAPE/KEY indicator to TAPE.
- b. Press the FWD/REV indicator to FWD.
- c. Press the IND/CONT indicator to CONT.
- d. Press the LOAD/INH indicator to LOAD.

NOTE: This Section initializes the AGC, loads the Theta-D update, ERSATZV36, entry Theta-D and nightwatchman alarm reset programs into AGC E-Memory, then advances the G&N System to the ZERO ENCODE Mode.

- e. Press the RUN indicator switch to RUN. Wait 90 seconds after tape stops before proceeding for ZERO ENCODE to extinguish.

6.2.14.7.5 Pitch Error (+5° and -5°)

6.2.14.7.5.1 Press the RUN indicator switch to RUN. Wait until tape stops.

6.2.14.7.5.2 Verify R1 indicates 00001 on CRT.

6.2.14.7.5.3 Enter the code 2 013 000 000 into C-START Module 4A1-A5-C156. press the XEQ/SEAL pushbutton to call up CG 2209 SCS PITCH ERROR on 4A1-A3-CHI.

6.2.14.7.5.4 Press 5mm/sec on Analog Recorder 4A1-A3.

NOTE: The readings on Recorder must be taken immediately after the transients have died out.

6.2.14.7.5.5 Press the RUN indicator switch on 4A4-k148 to RUN. Wait until tape stops.

6.7.14.7.5.6 After transients have died out, stop the recorder (4A1-A3). Record the magnitude of the initial value (0 + 1.00 degrees) and the final value (+5, +1.37, -1.23 degrees) of CG 2209. Record the phase.

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- 6.2.14.7.5.7 Record the values of the following signals in Table IX on the CRT. Be sure to record the associated sign.

Table IX Signal Requirements

<u>Signals</u>	<u>Requirements</u>
a. CG 2209 SCS PITCH	+5, +1.37, -1.23 degrees
b. CG 2239 SCS YAW BODY	0.0 \pm 1.00 degrees
c. CG 2241 SCS YAW OFFSET	0.0 \pm 1.00 degrees
d. CG 2269 SCS ROLL BODY	0.0 \pm 1.00 degrees
e. CG 2271 SCS ROLL OFFSET	UUU to LLL degrees

- 6.2.14.7.5.8 Record the value of the pitch channel of the IMU-CDU DIFFERENCE Meter. The INNER indicator or the IMU-CDU DIFFERENCE METER shall be -5 \pm 1.0 degrees.

- 6.2.14.7.5.9 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

- 6.2.14.7.5.10 Verify R1 indicates 00002 on CRT.

- 6.2.14.7.5.11 Start Analog Recorder 4A1-A3 chart drive at 5 mm/sec.

NOTE: The readings on the Recorder 6.2.14.7.5.13 and CRT 6.2.14.7.5.14 must be taken immediately after transients have died out.

- 6.2.14.7.5.12 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

- 6.2.14.7.5.13 After the transients have died out, stop recorder 4A1-A3. Record the magnitude of the initial (0 \pm 1.00) and the final value (-5, +1.23, -1.37 degrees) of CG 2209 SCS Pitch Error. Record phase.

- 6.2.14.7.5.14 Record the values of the following signals in Table X on the CRT.

Table X Signal Requirements

<u>Signal</u>	<u>Requirements</u>
a. CG 2209 PITCH ERROR	-5, +1.23, -1.37 degrees
b. CG 2239 SCS YAW BODY	0.0 \pm 1.00 degrees
c. CG 2241 SCS YAW OFFSET	0.0 \pm 1.00 degrees
d. CG 2269 SCS ROLL BODY	0.0 \pm 1.00 degrees
e. CG 2271 SCS ROLL OFFSET	UUU to LLL degrees

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6.2.14.7.6.10 Verify R1 indicator 00004 on CRT.

6.2.14.7.6.11 Start Analog Recorder 4A1-A3 chart drive at 5 mm/sec.

NOTE: The readings on the Recorder and CRT must be taken immediately after the transients have died out.

6.2.14.7.6.12 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.14.7.6.13 After the transients have died out, stop recorder 4A1-A3. Record the initial (0 + 1.00 degrees) and final (-4.20 + 1.18, -1.32 degrees) values of CG 2239 SCS YAW BODY ERROR on the high rate channel.

6.2.14.7.6.14 Record the value of the following signals in Table XII on CRT.

Table XII Signal Requirements

<u>Signals</u>	<u>Requirements</u>
a. CG 2209 SCS PITCH ERROR	0 + 1.00 degrees
b. CG 2239 SCS YAW BODY	-4.20, +1.18, -1.32 degrees
c. CG 2241 SCS YAW OFFSET	-5.00, +1.23, -1.37 degrees
d. CG 2269 SCS ROLL BODY	-2.70, +1.11, -1.23 degrees
e. CG 2271 SCS ROLL OFFSET	LLL to UUU degrees

6.2.14.7.6.15 Record indications on the MIDDLE GIMBAL channel of the IMU-CDU DIFFERENCE Meter. The MIDDLE indicator on the IMU-CDU DIFFERENCE Meter shall be +5.0 + 1.0 degrees. Record phase.

6.2.14.7.7 Roll Error (+5.0 and -5.0 degrees)

6.2.14.7.7.1 Enter the code 2 022 000 000 into C-START Module 4A1-A5-C156. Press the ZEQ/SEAL pushbutton to call up CG 2269 SCS ROLL BODY Error on 4A1-A3-CH1 or 2.

6.2.14.7.7.2 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.14.7.7.3 Verify R1 indicator 00005 on CRT.

6.2.14.7.7.4 Start Analog Recorder 4A1-A3 at a chart speed of 5 mm/sec.

NOTE: The readings on the Recorder and CRT must be taken immediately after the transients have died out.

6.2.14.7.7.5 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

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- 6.2.14.7.5.15 Record the value of the PITCH channel of the IMU-CDU DIFFERENCE Meter. The INNER indicator on the IMU-CDU DIFFERENCE Meter shall be $+5 \pm 1.0$ degrees.
- 6.2.14.7.6 Yaw Error (+5.0 and -5.0 degrees)
- 6.2.14.7.6.1 Enter the code 2 015 000 000 into C-START Module 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2239 SCS YAW BODY ERROR on 4A1-A5-CHI.
- 6.2.14.7.6.2 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.
- 6.2.14.7.6.3 Verify R1 indicator 00003 on CRT.
- 6.2.14.7.6.4 Start Analog Recorder 4A1-A3 chart drive at 5 mm/sec.
- NOTE: The readings on the Recorder 6.2.14.7.6.6 and CRT 6.2.14.7.6.7 must be taken immediately after the transients have died out.
- 6.2.14.7.6.5 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.
- 6.2.14.7.6.6 After the transients have died out, stop recorder 4A1-A3. Record the initial (0 ± 1.00 degrees) and final (+4.23, +1.32, -1.18 degrees) values of CG 2239 SCS YAW BODY. Record phase angles.
- 6.2.14.7.6.7 Record the value (including sign) of the following signals in Table XI on the CRT.

Table XI

Signal Requirements

<u>Signals</u>	<u>Requirements</u>
a. CG 2209 SCS PITCH ERROR	0 ± 1.00 degrees
b. CG 2239 SCS YAW BODY	+4.20, +1.32, -1.18 degrees
c. CG 2241 SCS YAW OFFSET	+5.00, +1.37, -1.23 degrees
d. CG 2269 SCS ROLL BODY	+2.70, +1.23, -1.11 degrees
e. CG 2271 SCS ROLL OFFSET	LLL to UUU

- 6.2.14.7.6.8 Record indications on MIDDLE GIMBAL channel of the IMU-CDU DIFFERENCE Meter. The MIDDLE indicator on the CDU-IMU DIFFERENCE Meter shall be -5.0 ± 1.0 degrees.
- 6.2.14.7.6.9 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

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6.2.14.7.7.6 After the transients have died out, stop recorder 4A1-A3. Record the initial (0 ± 1.00 degrees) and final ($+4.20$, $+1.32$, -1.18 degrees) values of CG 2269, SCS ROLL BODY ERROR on the high rate channel. Record phase.

6.2.14.7.7.7 Record the value (including the sign) of the signals specified on the CRT and shown in Table XIII.

Table XIII Signal Requirements

<u>Signals</u>	<u>Requirements</u>
a. CG 2209 SCS PITCH ERROR	0 ± 1.00 degrees
b. CG 2239 SCS YAW BODY	-2.70 , $+1.11$, -1.23 degrees
c. CG 2241 SCS YAW OFFSET	0 ± 1.00 degrees
d. CG 2269 SCS ROLL BODY	$+4.20$, $+1.32$, -1.18 degrees
e. CG 2271 SCS ROLL OFFSET	$+UUU$ degrees

6.2.14.7.7.8 Record indications of the OUTER GIMBAL channel of the IMU-CDU DIFFERENCE Meter. The OUTER GIMBAL indicator on the IMU-CDU DIFFERENCE Meter shall be -5.0 ± 1.0 degrees.

6.2.14.7.7.9 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.14.7.7.10 Verify R1 indicator 00006 on CRT.

6.2.14.7.7.11 Start Analog Recorder 4A1-A3 at a chart speed of 5 mm/sec.

NOTE: The readings on the Recorder and CRT must be taken immediately after the transients have died out.

6.2.14.7.7.12 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.14.7.7.13 After the transients have died out, stop recorder 4A1-A3. Record the initial (0 ± 1.00 degrees) and final (-4.20 , $+1.18$, -1.32 degrees) of CG 2269, SCS ROLL BODY ERROR on the high rate channel. Record phase.

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6.2.14.7.7.14 Record the value (including the sign) of the following signals in Table XIV on the CRT.

Table XV Signal Requirements

<u>Signals</u>	<u>Requirements</u>
a. CG 2209 SCS PITCH ERROR	0 ± 1.00 degrees
b. CG 2239 SCS YAW BODY	+2.70, +1.23, -1.11 degrees
c. CG 2241 SCS YAW OFFSET	0 ± 1.00 degrees
d. CG 2269 SCS ROLL BODY	-4.20, +1.18, -1.32 degrees
e. CG 2271 SCS ROLL OFFSET	-1.11 degrees

6.2.14.7.7.15 Record indications of the OUTER GIMBAL channel of the IMU-CDU DIFFERENCE Meter. The OUTER GIMBAL indicator on the IMU-CDU DIFFERENCE Meter shall be $+5.0 \pm 1.0$ degrees.

6.2.14.7.8 Verify that the K-RELAYS on CRT indicates 010000.

6.2.14.8 Entry Mode

6.2.14.8.1 Yaw Offset Error (+5 degrees)

6.2.14.8.1.1 Enter the code 2 016 000 000 into C-START Mode 4A1-A5-C156. Press XEQ/SEAL pushbutton to call up CG 2241 SCS YAW OFFSET ERROR on 4A1-A4-CH1 or 2.

6.2.14.8.1.2 Press the RUN indicator switch on 4A4-A3-K148 to RUN. Wait until tape stops.

6.2.14.8.1.3 Verify R1 indicator 00007 on CRT.

6.2.14.8.1.4 Start Analog Recorder 4A1-A3 chart drive at 5 mm/sec.

NOTE: The readings on the recorder and CRT must be taken immediately after the transients have died out.

6.2.14.8.1.5 Press the RUN indicator switch on 4A4-A3-K148 to RUN. Wait until tape stops.

6.2.14.8.1.6 After the transients have died out stop recorder 4A1-Ae and record the initial (0 ± 1.00 degrees) and final (+5.0, +1.37, -1.23 degrees) of CG 2241 YAW OFFSET ERROR on the high rate channel. Record phase.

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- 6.2.14.8.1.7 Record the amplitude (and sign) of the following signals in Table XV on the CRT.

Table XV Signal Requirements

<u>Signals</u>	<u>Requirements</u>
a. CG 2209 SCS PITCH ERROR	0.00 \pm 1.00 degrees
b. CG 2239 SCS YAW BODY	+4.20, +1.32, -1.18 degrees
c. CG 2241 SCS YAW OFFSET	+5.0, +1.37, -1.23 degrees
d. CG 2271 SCS ROLL OFFSET	LIL to UUU degrees

- 6.2.14.8.1.8 Record indications of the MIDDLE GIMBAL channel of the IMU-CDU DIFFERENCE Meter. The MIDDLE GIMBAL indicator of the IMU-CDU DIFFERENCE Meter shall be -5.0 \pm 1.0 degrees.

- 6.2.14.8.2 Roll Offset Error (+5 degrees)

- 6.2.14.8.2.1 Enter the code 2 024 000 000 into C-START Module 4A1-A5-C156. Press EXQ/SEAL pushbutton to call up CG 2271 SCS ROLL OFFSET ERROR on 4A1-A3-CH1 or 2.

- 6.2.14.8.2.2 Press the RUN indicator switch on 4A4-A3-K148 to RUN. Wait until tape stops.

- 6.2.14.8.2.3 Verify R1 indicates 00008.

- 6.2.14.8.2.4 Start Analog Recorder 4A1-A3 chart drive at 5 mm/sec.

NOTE: At the end of tape reading the IMU will be in FINE ALIGN Mode for 100 seconds. The IMU will then proceed to ENTRY Mode. The readings on the recorder 6.2.14.8.2.6 and CRT 6.2.14.8.2.7 must be taken immediately after the transients have died out.

- 6.2.14.8.2.5 Press the RUN indicator switch on 4A4-A3-K148 to RUN. Wait until tape stops.

- 6.2.14.8.2.6 After the transients have died out, stop recorder 4A1-A3 and record the initial (0 \pm 1.00 degrees) and final (+5.00, +1.62, -1.38 degrees) of CG 2271 SCS ROLL OFFSET ERROR on the high rate channel. Record phase.

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6.2.14.8.2.7 Record the value (including the sign) of each of the following signals in Table XVI monitored on the CRT.

Table XVI Signal Requirements

<u>Signals</u>	<u>Requirements</u>
a. CG 2209 SCS PITCH ERROR	0 \pm 1.00 degrees
b. CG 2239 SCS YAW BODY ERROR	+0.17, +1.09, -0.05 degrees
c. CG 2241 SCS YAW OFFSET ERROR	0 \pm 1.00 degrees
d. CG 2271 SCS ROLL OFFSET ERROR	+5.00, +1.62, -1.38 degrees

6.2.14.8.2.8 Record the indications on all channels of the IMU-CDU DIFFERENCE Meter. The OUTER and INNER values shall be 0.0 \pm 1.0 degrees. MIDDLE value shall be 0.30 \pm 1.0 degrees.

6.2.14.8.3 Pitch Error (+5 degrees)

6.2.14.8.3.1 Enter the code 2 013 000 000 into C-START 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2209 SCS PITCH on 4A1-A3-CH1.

6.2.14.8.3.2 Press the RUN indicator switch on 4A4-A3-K148 to RUN. Wait until tape stops.

6.2.14.8.3.3 Verify R1 indicator 00009.

6.2.14.8.3.4 Start Analog Recorder 4A1-A3 chart drive at 5 mm/sec.

NOTE: The readings on the recorder 6.2.14.8.3.6 and CRT 6.2.14.8.3.7 must be taken immediately after the transients have died out.

6.2.14.8.3.5 Press the RUN indicator switch on 4A4-A3-K148 to RUN. Wait until tape stops.

6.2.14.8.3.6 After the transients have died out stop recorder 4A1-A3 and record the initial (0 \pm 1.00 degrees) and final (+5.0, +1.37, -1.23 degrees) of CG 2209 SCS PITCH ERROR on the high rate channel. Record phase.

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- 6.2.14.8.3.7 Record the value of the following signals in Table XVII on the CRT.

Table XVII Signal Requirements

<u>Signal</u>	<u>Requirements</u>
a. CG 2209 SCS PITCH ERROR	+5.0, +1.37, -1.23 degrees
b. CG 2239 SCS YAW BODY	0 + 1.00 degrees
c. CG 2241 SCS YAW OFFSET	0 + 1.00 degrees
d. CG 2271 SCS ROLL OFFSET	LLL to UUU degrees

- 6.2.14.8.4 The INNER GIMBAL on IMU-CDU DIFFERENCE Meter shall be -5.0 ± 1.0 degrees.

- 6.2.14.8.5 Verify that the K-RELAYS on CRT-P17B-L19 indicates 100000.

- 6.2.14.8.6 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

- 6.2.14.8.7 Verify COARS ALIGN mode lamp is the only mode lighted on the IMU-CDU CONTROL PANEL.

- 6.2.14.8.8 Verify OUTER, INNER, and MIDDLE GIMBAL angles on the CDU panel indicate 0.0 ± 0.100 degrees.

- 6.2.15 Gimbal Friction Test

- 6.2.15.1 Obtain the Gimbal Friction Test Tape No. F04C014-K00031-00 and install on TAPE READER.

- 6.2.15.2 Set the POWER/ON Switch on the TAPE READER 4A4-A2 to ON. Perform the following steps on Console 4A4-A3 in sequence:

- Press the TAPE/KEY indicator to TAPE.
- Press the FWD/REV indicator to FWD.
- Press the IND/CONT indicator to CONT.
- Press the LOAD/INH indicator to LOAD.

- 6.2.15.3 Set up Analogue Recorder 4A1-A3 to monitor the following signals:

- CG 2110 IGA TM IN
- CG 2140 MGA TM IN
- CG 2170 OGA TM IN

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- 6.2.15.4 Press RUN indicator on K-148. Wait 90 seconds after tape stops.
- 6.2.15.5 Press RUN indicator on K-148. Wait 60 seconds after tape stops.
- 6.2.15.6 Press RUN indicator on K-148. Wait for tape to stop.
- 6.2.15.7 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 to initiate IG Clockwise Friction Test. After about 9 minutes observe CRT. When IG CDU angle indication stops changing, stop analog recorder. IG CDU angle should be 000 ± 010 degrees.
- 6.2.15.8 Repeat 6.2.15.5 and 6.2.15.6.
- 6.2.15.9 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 to initiate IG Counter clockwise Friction Test. After about 9 minutes observe CRT. When IG CDU angle stops changing, stop analog recorder. IG CDU angle should be 000 ± 010 degrees.
- 6.2.15.10 Repeat 6.2.15.5 and 6.2.15.6.
- 6.2.15.11 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 to initiate OG Clockwise Friction Test. After about 9 minutes, observe CRT. When OG CDU angle stops changing, stop analog recorder. OG CDU angle should be 000 ± 010 degrees.
- 6.2.15.12 Repeat 6.2.15.5 and 6.2.15.6.
- 6.2.15.13 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 to initiate OG Counter-clockwise Friction Test. After about 9 minutes, observe CRT. When OG CDU angle stops changing, stop analog recorder. OG CDU angle should be 000 ± 010 degrees.
- 6.2.15.14 Repeat 6.2.15.5 and 6.2.15.6.
- 6.2.15.15 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 to initiate MG Clockwise Friction Test. After about 3 minutes, observe CRT. When MG CDU angle stops changing, stop analog recorder. MG CDU angle should be $+050 \pm 010$ degrees.
- 6.2.15.16 Repeat 6.2.15.5 and 6.2.15.6.
- 6.2.15.17 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 to initiate MG Counter-clockwise Friction Test. After about 3 minutes, observe CRT. When MG CDU angle stops changing, stop analog recorder. MG CDU angle should be $+310 \pm 010$ degrees.

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- 6.2.15.18 Press RUN indicator on K- 148. Wait for tape to stop and remove from TAPE READER.
- 6.2.15.19 Observe the six active traces on the analog recorder. Determine that none of the traces indicate greater than 7.5 VDC for a period not to exceed 5MM throughout the range of the active trace.

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6.2.16 Stabilization Loop Step Response Test

6.2.16.1 Proceed with this test if 6.2.4, Operate Power On Test has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2 Turn On Procedures before proceeding. Ensure that the Carry-on Command Stimuli Unit, Model No. C14-200, is installed and connected.

6.2.16.2 Ensure G&N System is in the COARSE ALIGN mode under AGC control.

6.2.16.3 Set the TRANSFER switch on the IMU CONTROL Panel to COMPUTER.

Note: The computer PROGRAM ALARM will be lighted. Disregard and press ERROR RESET button on LEB DSKY.

6.2.16.5 Inner Gimbal Response Test

6.2.16.5.1 Enter the code 2 010 000 000 in C-START Module 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2107 IGA SERVO ERROR on 4A1-A3-CH1.

6.2.16.5.2 Insert the following sequence into K148:

a. VERB 41, NOUN 20, ENTER

b. +00000 ENTER

c. +00000 ENTER

d. +00000 ENTER

Wait 60 seconds

6.2.16.5.3 Insert VERB 36 into K148. Press ENTER pushbutton.

6.2.16.5.4 Enter 1000 into 4A2-A6-R155. The top part of switch should be lighted. Ensure that no other function switches on 4A2-A6-R155 are lighted.

6.2.16.5.5 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a 2 ± 0.2 VDC step into the IG Stabilization Loop.

NOTE: If the transient cause by the step input does not die out within 5 seconds, remove IMU OPERATE power by opening the IMU MN A & MN B circuit breaker on the right hand circuit breaker panel.

6.2.16.5.6 Start Analog Recorder 4A1-A3 using a chart speed of 20 MM/SEC.

6.2.16.5.7 Enter 0000 into 4A2-A6-R155; the top part of switch should be out. Ensure that no other function switches on 4A2-A6-155 are lighted. Press XEQ/SEAL pushbutton to remove the step input to the IG Stabilization Loop. The bottom part of switch shall go out. 96

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- 6.2.16.5.8 After transient has died out, stop Analog Recorder. Record the loop response time by measuring the time interval between removing the step (initial disturbance) and the peak of the first overshoot. In addition, record the total number of overshoots.
- 6.2.16.5.8.1 The Inner Gimbal stabilization loop response time shall be less than 0.8 seconds.
- 6.2.16.5.8.2 The maximum number of overshoots on the torque motor input signals shall be two.
- 6.2.16.6 Middle Gimbal Response Test
- 6.2.16.6.1 Enter the code 2 021 000 000 into C-START MODULE 4A1-A5-0156. Press the XEQ/SEAL pushbutton to call up CG 2137 MGA SERVO ERROR on 4A1-A3-CH1.
- 6.2.16.6.2 Insert the following sequence into K148
- a. VERB 41, NOUN 20 ENTER
 - b. +00000 ENTER
 - c. +00000 ENTER
 - d. +00000 ENTER
- Wait 60 seconds
- 6.2.16.6.3 Insert VERB 36 into K148. Press ENTER pushbutton.
- 6.2.16.6.4 Enter 0100 into 4A2-A6-R155 to enter a 2.0 \pm 0.2 VDC step into the MG Stabilization Loop.
- NOTE: If the transient caused by the step input does not die out within 5 seconds, remove IMU OPERATE power by opening the IMU MNA & MNB circuit breaker on the Right Hand Circuit Breaker panel.
- 6.2.16.6.6 Start Analog Recorder 4A1-A3 using a chart speed of 20 MM/SEC.
- 6.2.16.6.7 Enter 0000 into 4A2-A6-R155. The top part of switch shall go out. Ensure that no other function switches on 4A2-A6-R155 are lighted. Press the XEQ/SEAL pushbutton to remove the step input to the MG Stabilization Loop.
- 6.2.16.6.8 After transients have died out, stop Analog Recorder. Record the loop response time by measuring the time interval between removing the step (initial disturbance) and the peak of the first overshoot. In addition, record the total number of overshoots.

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- 6.2.16.6.8.1 The Middle Gimbal stabilization loop response time shall be less than 0.8 seconds.
- 6.2.16.6.8.2 The maximum number of overshoots on the torque motor input signals shall be two.
- 6.2.16.7 Outer Gimbal Response Test
- 6.2.16.7.1 Enter the code 2 025 000 000 C-START Module 4A1-A5-C156. Press XEQ/SEAL pushbutton to call up CG 2167 OGA SERVO ERROR On 4A1-A3-CH1.
- 6.2.16.7.2 Insert the following sequence into K148.
- a. VERB 41, NOUN 20, ENTER
 - b. +00000 ENTER
 - c. +00000 ENTER
 - d. +00000 ENTER
- Wait 60 seconds
- 6.2.16.7.3 Insert VERB 36 into K148. Press ENTER pushbutton.
- 6.2.16.7.4 Enter 0010 into 4A2-A6-R155. The top half of switch should be lighted. Ensure that no other function switches on 4A2-A6-R155 are lighted.
- 6.2.16.7.5 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a 2.0 + 0.2 VDC step into the OG Stabilization Loops.
- NOTE: If the transient caused by the step input does not die out within 5 seconds, remove IMU OPERATE power by opening the IMU MNA & MNB circuit breaker on the Right Hand Circuit Breaker Panel.
- 6.2.16.7.6 Start Analog Recorder 4A1-A3 using a chart speed of 20 MM/SEC.
- 6.2.16.7.7 Enter 0000 into 4A2-A6-R155. The top half of switch shall go out. Ensure that no other function switches on 4A2-A6-R155 are lighted. Press the XEQ/SEAL pushbutton to remove the stop input to the OG Stabilization Loop.
- 6.2.16.7.8 After transients have died out, stop Analog Recorder. Record the loop response time by measuring the time interval between removing the step (initial disturbance) and the peak of the first overshoot. In addition, record the total number of overshoots.

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6.2.16.7.8.1 The Outer Gimbal stabilization loop response time shall be less than 0.8 seconds.

6.2.16.7.8.2 The maximum number of overshoots on the OGA SERVO ERROR signals shall be two.

6.2.16.8 Insert the following sequence into K148

a. VERB 41, NOUN 20 ENTER

b. +00000 ENTER

c. +00000 ENTER

c. +00000 ENTER

6.2.17 IRIG Scale Factor Test

6.2.17.1 Proceed with this test if 6.2.4 Operate Power On Test or 6.2.2.2 Turn On Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2 before proceeding.

6.2.17.2 Set up Analog Recorders 4A3-A2 and 4A1-A2 to monitor the following signals:

Analog Recorder

a. CG 2110 IG TM INPUT 4A3-A2

b. CG 2140 MG TM INPUT 4A3-A2

c. CG 2170 OG TM INPUT 4A3-A2

d. CG 2117 IG SERVO ERROR 4A1-A2

e. CG 2147 MG SERVO ERROR 4A1-A2

f. CG 2177 OG SERVO ERROR 4A1-A2

6.2.17.3 Start Analog Recorder chart drive using a speed of 1 MM/Second. Recorder shall run for duration of this test.

6.2.17.4 Insert and verify the following sequence into K148.

VERB 57 ENTER

00005 ENTER

Observe 07 in MAJOR MODE

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- 6.2.17.5 VERB 21, NOUN 30 shall flash on CRT requesting a load of the test numbers. Select the desired Test Number from Table XVIII. Enter the appropriate + 0000X into K148. Press the ENTER pushbutton.

Table XVIII. Test Numbers and Positions for IRIG Tests

Test Number	Gyro being tested and Direction of torque
+00001	+X
-00001	-X
+00002	+Y
-00002	-Y
+00003	+Z
-00003	-Z

NOTE: If all gyros are being tested, the test must be repeated once for each Test Number in the above table. If only one gyro is being tested, the test need only be repeated for the two applicable Test Numbers.

- 6.2.17.6 During the following operation, disregard the CDU FAIL lamp indication unless specified:

The G&N System will automatically cycle through ZERO ENCODE, FINE ALIGN, ATT CONT, FINE ALIGN, COARS ALIGN and FINE ALIGN Modes. When alignment is completed for the specific IRIG under test, it will be torqued through approximately 360 degrees. There are six cycles of approximately 20 minutes each, which correspond to both plus and minus configurations of the X, Y, and Z IRIG's. The approach time period for one cycle test completion can be observed by performing the following sequences:

- Insert VERB 11, NOUN 01 into K148. Press ENTER pushbutton.
- Insert 01652 into K148. Press ENTER pushbutton.
- Verify on CRT that R1 is counting down octally. When R1 has counted to zero, VERB 07 and NOUN 30 will be flashing. This indicates completion of one of the six cycle IRIG test.

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- 6.2.17.7 Record the value displayed in register R1 CRT for the appropriate Test Number in Table XIX.

Table XIX. Display of Test Parameters

Test Number	Symbol	Display in R1
+00001	ΔE_{-X}	+ X X X X X
-00001	ΔE_{+X}	- X X X X X
+00002	ΔE_{-Y}	+ X X X X X
-00002	ΔE_{+Y}	- X X X X X
+00003	ΔE_{-Z}	+ X X X X X
-00003	ΔE_{+Z}	- X X X X X

- 6.2.17.8 Enter VERB 36 into K148. Press the ENTER pushbutton. Press The ERROR RESET switch on the LEB AGC DSKY.
- 6.2.17.9 Repeat 6.2.17.4 through 6.2.17.11 until all Test number in Table XVIII have been utilized.
- 6.2.17.10 After all completion of all test numbers, stop the Analog Recorder.
- 6.2.17.10.1 Enter VERB 40, NOUN 20 into K148. Press ENTER pushbutton. Wait 90 seconds.
- 6.2.17.10.2 Enter VERB 41, NOUN 20 into K148. Press ENTER pushbutton.
- 6.2.17.10.3 Enter +00000 into K148, three times, press ENTER pushbutton after each entry.
- 6.2.17.11 Perform the following calculations:

a. X IRIG Scale Factor Error

$$X_E = \frac{\Delta E_{+X} + \Delta E_{-X}}{2} \quad \text{parts/million}$$

b. Y IRIG Scale Factor Error

$$Y_E = \frac{\Delta E_{+Y} + \Delta E_{-Y}}{2} \quad \text{parts/Million}$$

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6.2.17.12 c. Z IRIG Scale Factor Error

$$Z_E = \frac{\Delta E_{+Z} + \Delta E_{-Z}}{2} \text{ parts/million}$$

6.2.1.12.1 The Scale Factor error deviation for each IRIG shall be less than + 1750 parts/million.

6.2.18 PIPA Scale Factor Determination Test

6.2.18.1 Proceed with this test if 6.2.2 Operate Power On Test or 6.2.2.2 Turn On Procedure has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2 Turn on Procedure before proceeding with this test.

6.2.18.2 Verify the IMU OPERATE power has been applied and that the IMU TEMP MODE switch has been in the AUTO OVERRIDE or PROPORTIONAL for a minimum of one hour.

6.2.18.3 Verify that the TRANSFER switch is set to COMPUTER position.

6.2.18.4 Test Initiation

6.2.18.4.1 Insert and verify the following sequence into K-148

6.2.18.4.1.1 a. VERB 57 ENTER

b. 00002 ENTER

Observe 07 in MAJOR MODE.

6.2.18.4.2 Observe VERB 06, MOUN 61 flashing. Rows R1 and R2 contain the NB azimuth and latitude respectively in degrees. If R1 and R2 agree with known azimuth and latitude insert VERB 33, ENTER into K148 and proceed to 6.2.18.4.4.

6.2.18.4.3 Insert and verify the following sequence into K148.

a. VERB 21 ENTER

b. +X X X X X (Correct NB azimuth) ENTER

c. VERB 22 ENTER

d. +28523 (Correct NB latitude) ENTER

e. VERB 33 ENTER

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6.2.18.4.4 Observe VERB 06 NOUN 66 flashing. Rows R1, R2 and R3 shall indicate:

R1 + 00032 (NB Tilt angle)
R2 - 00000 (Test Index)
R3 + 0000X (Test Position)

Where X indicates positions 1 through 6

NOTE: To complete this test, positions 1 through 6 shall be performed.

If R1, R2 and R3 agree with the above, insert VERB 33, ENTER into Kl48 and proceed to 6.2.18.4.6

6.2.18.4.5 Insert and verify the following sequence into Kl48.

a. VERB 21, NOUN 02 ENTER
b. 01313 ENTER
c. +00032 (Correct NB tilt) ENTER
d. VERB 21, NOUN 01 ENTER
e. 01314 ENTER
f. -00000 (Correct index) ENTER
g. VERB 21 NOUN 02 ENTER
h. 01305 ENTER
i. +0000X (position) ENTER
j. VERB 33 ENTER

6.2.18.4.6 After approximately 5 minutes record CRT indications of OG, IG and NG CDU angles.

6.2.18.4.7 After approximately 18 minutes, VERB 06 NOUN 66 will appear flashing Record R1 (XXXXX), R2 (.XXXXX) and R3 (position number).

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Table XXI

Position No. as Displayed in R3	PIPA Being Tested and its Orientation
00001	X PIPA Up
00002	X PIPA Down
00003	Z PIPA Up
00004	Z PIPA Down
00005	Y PIPA Up
00006	Y PIPA Down

- 6.2.18.4.8 If it is desired to perform the test in the next position, enter VERB 33 into Kl48. Press the ENTER pushbutton and return to 6.2.18.4. After completion of position 6, the test shall be terminated by entering VERB 34 into Kl48. Press the ENTER pushbutton.
- 6.2.18.4.9 Enter VERB 40, NOUN 20 into Kl48. Press the ENTER pushbutton.
- 6.2.18.4.10 Enter VERB 41 NOUN 20 into Kl48. Press the ENTER pushbutton.
- 6.2.18.4.11 Enter +00000 into Kl48. Press the ENTER pushbutton.
- 6.2.18.4.12 Enter +00000 into Kl48. Press the ENTER pushbutton.
- 6.2.18.4.13 Enter +00000 into Kl48. Press the ENTER pushbutton. The COARS ALIGN mode lamp shall light.
- 6.2.18.5 Calculations

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6.2.18.5.1 The values obtained from R1 and R2 for each position are combined as follows:

Contents of (R1)₁

Contents of (R2)₁

$$A_1 = +XXXXX$$

XXXXX

Where 1 = Position Number

$$A_1 = \text{-----}$$

$$A_2 = \text{-----}$$

$$A_3 = \text{-----}$$

$$A_4 = \text{-----}$$

$$A_5 = \text{-----}$$

$$A_6 = \text{-----}$$

6.2.18.5.2 Compute the average G for each PIPA using A₁ from step 1:

$$\text{a. for X - PIPA } G_x = \frac{A_1 - A_2}{2}$$

$$\text{b. for Z - PIPA } G_z = \frac{A_3 - A_4}{2}$$

$$\text{c. for Y - PIPA } G_y = \frac{A_5 - A_6}{2}$$

6.2.18.5.3 Compute the PIPA scale factors using five significant figures from 6.2.18.5.2 and the value of local gravity obtained from Table XXII.

$$h_x = \frac{5.85 (\text{local } g)}{G_x}$$

$$h_z = \frac{5.85 (\text{local } g)}{G_z}$$

$$h_y = \frac{5.85 (\text{local } g)}{G_y}$$

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6.2.18.5.3.1 These values shall fall within 400 PPM of the nominal SF of 5.85 cm/sec/pulse.

6.2.18.5.4 Compute the FIPA biases using the values computed in 6.2.18.5.1 and 6.2.18.5.2 as follows:

$$b_x = \frac{(A_1 + A_2)}{2} = \underline{\hspace{2cm}}$$

$$b_z = \frac{(A_3 + A_4)}{2} = \underline{\hspace{2cm}}$$

$$b_y = \frac{(A_5 + A_6)}{2} = \underline{\hspace{2cm}}$$

6.2.18.5.4.1 These values shall fall within 0.0 ± 0.50 cm/sec².

Table XXII. Local Gravity Requirements	
Location	Local Gravity (cm/sec ²)
MSC	979.24

6.2.18.6 Specification MA 0201-3179 Table III shall be utilized for calculations.

6.2.18.7 Verify FIPA Scale Factor Determination Test passed or failed.

6.2.19. IRIG Coefficient Determination Test

6.2.19.1 Proceed with this test if 6.2.4 Operate Power On Test or 6.2.2.2 Turn On Procedure has been performed, and system operation has not been interrupted. If system operation has been interrupted, perform Turn On Procedure of 6.2.2.2 before Proceeding with this test.

6.2.19.2 Verify or set transfer switch to COMPUTER.

6.2.19.3 Obtain, verify and record the azimuth orientation of Spacecraft Z Axis.

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6.2.19.4 Insert and verify the following sequence into K148.

a. VERB 57 ENTER

b. Observe VERB 21, NOUN 01 Flashing

c. 00001 ENTER

d. Observe 07 in MAJOR MODE

6.2.19.5 Observe VERB 06, NOUN 61 flashing. Rows R1 and R2 shall contain the nav base azimuth and test site latitude respectively. If the azimuth and latitude indications are in agreement with the known values for these parameters press VERB 33, ENTER on K148 and proceed to 6.2.18.7.

6.2.19.6 Insert and verify the following sequence into K148.

a. VERB 21 ENTER

b. X X X . X X (correct NB azimuth) ENTER

c. VERB 22 ENTER

d. X X X . X X (correct site latitude) ENTER

e. VERB 33 ENTER

6.2.19.7 Observe VERB 06, NOUN 66 flashing with Rows R1, R2, and R3 indicating:

R1 +00032

R2 +00000

R3 +00001

If the above indications are present on the CRT or DSKY insert VERB 33, ENTER into K148 and proceed to 6.2.19.9.

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6.2.19.8 Insert and verify the following sequence into K148.

a.	VERB 21	NOUN 02	ENTER
b.	01313		ENTER
c.	+00032		ENTER
d.	VERB 21	NOUN 02	ENTER
e.	01314		ENTER
f.	+00000		ENTER
g.	VERB 21	NOUN 02	ENTER
h.	01305		ENTER
i.	+00001		ENTER
j.	VERB 33		ENTER

6.2.19.9 The G&N system will now cycle through the following modes as indicated on the IMU CONTROL Panel.

- a. ZERO ENCODER
- b. FINE ALIGN
- c. ATT CONT
- d. FINE ALIGN
- e. COARS ALIGN
- f. FINE ALIGN

6.2.19.10 After approximately 90 seconds after the final FINE ALIGN mode is entered, record indication of IG, MG and OG CDU's and the time.

6.2.19.11 After approximately 14 minutes, when VERB 06, NOUN 66 appears flashing, record indication of R1, R2, IG, MG, OG CDU'S and time.

NOTE: R1 should be \pm 00000.

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6.2.19.12 To repeat test for positions 2 through 6 insert VERB 33 ENTER twice into K148 after performing 6.2.18.11 for each position except after position 6.

6.2.19.13 Insert and verify the following sequence into K148:

a. VERB 33	ENTER
b. Observe VERB 06, NOUN 66	flashing
c. VERB 21 NOUN 02	ENTER
d. 01313	ENTER
e. +00032	ENTER
f. VERB 21 NOUN 02	ENTER
g. 01314	ENTER
h. +00001	ENTER
j. VERB 21 NOUN 02	ENTER
k. 01305	ENTER
l. +00001	ENTER
m. VERB 33	ENTER

NOTE: Approximately 90 seconds after the final entry into the FINE ALIGN mode (f below) perform 6.2.19.15.

6.2.19.14 The G&N System will now cycle through the following mode as indicated on the IMU CONTROL panel.

- a. ZERO ENCODER
- b. FINE ALIGN
- c. ATT CONT
- d. FINE ALIGN
- e. COARS ALIGN
- f. FINE ALIGN

6.2.19.15 Insert and verify the following sequence into K148:

a. VERB 06	NOUN 20	ENTER
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6.2.19.16 Record the indications of LEB DSKY rows R1, R2, R3 and the time.

6.2.19.17 After approximately 14 minutes, when VERB 06, NOUN 66 appears flashing record indication of R1, R2, 0G, 1G, MG CDU'S and time.

6.2.19.18 Repeat the test for positions 2 through 6 by inserting VERB 33 ENTER into K148 after 6.2.19.17 and then performing 6.2.19.13. m through 6.2.19.17.

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6.2.19.19 After performing position 6 terminate test by inserting VERB 34
ENTER into K148.

6.2.19.20 Insert and verify the following sequence into K148:

a. VERB 41, NOUN 20, ENTER

b. +00000 ENTER

c. +00000 ENTER

d. +00000 ENTER

6.2.19.21 The data recorded for positions 1 through 6 when performing
6.2.19.11 has the following meaning:

Position Displayed Drift Coefficients

1 +MBDY

2 +MBDZ

3 +MBDX

4 +MBDY + ADGRAY

5 +MBDZ + ADSRAZ

6 +MBDX + ADSRAX

6.2.19.22 The data recorded for positions 1 through 6 when performing
6.2.19.16 and 6.2.19.17 shall be utilized on the calculations
sheets to derive the ADIA terms.

6.2.19.23 The following terms shall be solved for and have the following
tolerances with respect to the last performance of JDC 15236,
15237, 15239, 15240, 15242, 15243 found in the G&N System Data
Package:

$MBD \pm 00500 = \pm 7 \text{ meru}$

$ADGRA \pm 01000 = \pm 12 \text{ meru}$

$ADIA \pm 02000 = \pm 20 \text{ meru}$

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6.2.20 Fine Alignment Test

6.2.20.1 Proceed with this test if 6.2.4 Operate Power on Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2 Turn On Procedure.

6.2.20.2 Prior to performing this test, the G&N Installation Qualification Fixture shall be installed on the supporting fixture and adjusted to permit proper operation of the G&N optics. The azimuth supplied by the azimuth autosect (Ref. No. 1) shall be known to ± 30 minutes of arc.

NOTE: G&N System shall have had OPERATE power applied for a minimum of one hour. System shall be in COARSE ALIGN mode under computer control with gimbal angles at zero.

NOTE: Insure that G&N Optics MNA and MNB breakers are pushed in (ON).

6.2.20.3 Set OPTICS mode switch to ZERO OPTICS. After ZERO ENCODER lamp has extinguished on Condition Annunciator panel, return OPTICS mode switch to MANUAL.

6.2.20.4 Initiate the test by inserting the following into K148:

- a. VERB 57 ENTER
- b. Observe VERB 21, NOUN 01 flashing
- c. 00003 ENTER
- d. Observe PROGRAM lights, 07

6.2.20.5 Observe that the ZERO ENCODER lamps on Condition Annunciator and IMU CONTROL panel light and then extinguish.

6.2.20.6 Observe VERB 06, NOUN 61 flashing with the following display:

- a. R1 + xxx.xx (45.000, + S/C AZ degrees)
- b. R2 + 00000 (TGT 1 EL, degrees)
- c. R3 00001 (TGT number)

If R1 and R2 are correct for present location insert VERB 33, ENTER into K148 and proceed to 6.2.20.9.

6.2.20.7 To correct R1, insert and verify the following into K148:

- a. VERB 21 ENTER
- b. + xxx.xx (45.000 + S/C AZ) ENTER

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6.2.20.8 To correct R2, insert and verify the following into K148:

- a. VERB 22 ENTER
- b. + 00000 ENTER
- c. VERB 33 ENTER

6.2.20.9 Observe VERB 06, NOUN 61 flashing with the following display:

- a. R1 - xxx.xx (-45.000 + S/C AZ degrees)
- b. R2 + 00000 (TOT 2 EL, degrees)
- c. R3 00002 (TOT number)

6.2.20.10 If R1 and R2 are correct for present location insert VERB 33, ENTER into K148 and proceed to 6.2.20.12.

6.2.20.10 To correct R1, insert and verify the following into K148:

- a. VERB 21 ENTER
- b. + xxx.xx (-45.000 + S/C AZ) ENTER

6.2.20.11 To correct R2, insert and verify the following into K148:

- a. VERB 22 ENTER
- b. + 00000 ENTER
- c. VERB 33 ENTER

6.2.20.12 Observe VERB 06, NOUN 61 flashing with the following display.

- a. R1 + 13500 (SM A2)
- b) R2 + 28516 (LAT)

If R1 and R2 are correct for present location, insert VERB 33, ENTER into K148 and proceed to 6.2.20.15.

6.2.20.13 To correct R1 insert and verify the following into K148:

- a. VERB 21 ENTER
- b. + 13500 (correct SM A2) ENTER

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- 6.2.20.14 To correct R2 insert and verify the following into K148:
- a. VERB 22 ENTER
 - b. + 28516 (correct LAT) ENTER
 - c. VERB 33 ENTER
- 6.2.20.15 Observe VERB 21, NOUN 30 flashing, insert and verify 00001, ENTER into K148.
- 6.2.20.16 Observe VERB 51 flashing with R1 indicating 00001. Sight through SXT and align with TOT 1. Upon reticle coincidence, press MARK pushbutton. If satisfied with alignment, press ENTER pushbutton on DSKY. (If not satisfied with alignment, insert and verify VERB 52, ENTER into DSKY and repeat above procedure.)
- 6.2.20.17 Observe VERB 51 flashing with R1 indicating 00002. Sight through SXT and align with TOT 1. Upon reticle coincidence, press MARK pushbutton. If satisfied with alignment, press ENTER pushbutton on DSKY. (If not satisfied with alignment, insert and verify VERB 52, ENTER into DSKY and repeat above procedure.)
- 6.2.20.18 During approximately the next 3.5 minutes the following IMU moding will occur as indicated on the IMU CONTROL panel.
- a. ZERO ENCODE
 - b. FINE ALIGN
 - c. ATTITUDE CONTROL
 - d. FINE ALIGN
 - e. COARSE ALIGN
 - f. FINE ALIGN
- 6.2.20.19 Repeat 6.2.20.16 and 6.2.20.17.
- 6.2.20.20 Approximately 7 minutes after the IMU enters the FINE ALIGN mode, VERB 06, NOUN 66 will flash. R1 (whole) and R2 (fractional) will contain the misalignment (arc sec) of the Y PIPA IA about the Z_{gm} . Record and insert VERB 33, ENTER. R1 (whole) and R2 (fractional) will contain the misalignment (arc sec) of the Z PIPA IA about the Y_{gm} . Record R1 and R2.
- 6.2.20.21 Insert and verify VERB 34, ENTER into K148.
- 6.2.20.22 Repeat 6.2.20.4 through 6.2.20.14.

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- 6.2.20.23 Observe VERB 21, NOUN 30 flashing, insert and verify 00002, ENTER into K148.
- 6.2.20.24 Repeat 6.2.20.16 through 6.2.20.19.
- 6.2.20.25 Approximately 7 minutes after the IMU enters the FINE ALIGN mode, VERB 06, NOUN 66 will flash. R1 (whole) and R2 (fractional) will contain the misalignment (arc sec) of the X PIPA IA about the Z_{SM}. Record and insert VERB 33, ENTER. R1 (whole) and R2 (fractional) will contain the misalignment (arc sec) of the Y PIPA IA about X_{SM}. Record R1 and R2.
- 6.2.20.26 Insert and verify VERB 34, ENTER into K148.
- 6.2.20.27 Repeat 6.2.20.4 through 6.2.20.14.
- 6.2.20.28 Observe VERB 21, NOUN 30 flashing, insert and verify 00003, ENTER into K148.
- 6.2.20.29 Repeat 6.2.20.16 through 6.2.20.19.
- 6.2.20.30 Approximately 7 minutes after the IMU enters the FINE ALIGN mode, VERB 06, NOUN 66 will flash. R1 (whole) and R2 (fractional) will contain the misalignment (arc sec) of the X PIPA IA about the Z_{SM}. Record and insert VERB 33, ENTER. R1 (whole) and R2 (fractional) will contain the misalignment (arc sec) of the Z PIPA IA about the X_{SM}. Record R1 and R2.
- 6.2.20.31 Insert and verify the following into K148:
- | | |
|-----------------------|-------|
| a. VERB 34 | ENTER |
| b. VERB 41 NOUN 20 | ENTER |
| c. + 00000 | ENTER |
| d. + 00000 | ENTER |
| e. + 00000 | ENTER |
- 6.2.20.32 The misalignment angle of an IA about any SM axis shall be 150 arc seconds or less.
- 6.2.20.33 Remove OPTICS power by pulling out OPTICS MNA and MNB breakers on Right Hand Circuit Breaker Panel.

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6.2.21 Gyrocompassing Test

- 6.2.21.1 Proceed with this test if the Operate Power On Test 6.2.4 or the Turn On Procedure of 6.2.2.2 has been completed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.2.2 before proceeding.
- 6.2.21.2 Load the Gyrocompassing Data Load Tape (F04C014K00033-00) on the tape reader. This tape loads nominal IRIG and PIPA parameters for G&N 121 and also loads gyrocompassing azimuth, latitude and Nav. Base azimuth for testing in the MSOB. After display and verification of the data load, the tape will initiate the Prelaunch Alignment Program.
- 6.2.21.3 Apply G&N OPTICS power by pushing in OPTICS MNA and MNB breakers on Right Hand Circuit Breaker panel.
- 6.2.21.4 Start the tape reader. After the tape reader stops, the data load may be changed by performing the following sequences.
- 6.2.21.4.1 If required to change the IRIG or PIPA data load:
- Convert the data from engineering units to the AGC octal as stored in erasable memory.
 - Load the actual data into the AGC by inserting the following sequence into K148.
- VERB 21 NOUN 02 ENTER
YYYYY ENTER (E-Memory address from Table XXIII)
XXXXX ENTER (Octal data)
- 6.2.21.4.2 If required to change the gyrocompassing azimuth data load:

- Perform the following calculation:

$$\frac{\text{Gyrocompassing Azimuth}}{360} \times 16384 = \text{AAAA.BBBBB}$$

- Load correction into AGC by inserting the following sequence into K148:

VERB 21 NOUN 02 ENTR
01506 ENTR
S0AAAA ENTR (S = sign)
VERB 21 NOUN 01 ENTR
01507 ENTR
SBBBBB ENTR

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TABLE XXIII

IMU COMPENSATION TERMS

IMU COMPENSATION TERM	ADDRESS
NBDX	00745
NBDY	00746
NBDZ	00747
ADLAX	00750
ADLAY	00751
ADLAZ	00752
ADSRAX	00753
ADSRAY	00754
ADSRAZ	00755
PIPA X BIAS	00737
PIPA X SF	00740
PIPA Y BIAS	00741
PIPA Y SP	00742
PIPA Z BIAS	00743
PIPA Z SF	00744

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6.2.21.4.3 If required to change the nav. base azimuth data load:

- a. Perform the following calculation:

$$\frac{\text{Nav. Base Azimuth}}{360} \times 16384 = \text{EEEE.PFFFF}$$

- b. Load correction into AGC by inserting the following sequence into K148:

VERB 21	NOUN 02	ENTR
01614	ENTR	
90EEKE	ENTR	(S - sign)
VERB 21	NOUN 01	(ENTR)
01615	ENTR	
SFFFFF	ENTR	

6.2.21.4.4 If required to change the latitude data load:

- a. Perform the following calculation:

$$\frac{\text{latitude}}{360} \times 16384 = \text{M494.HHNNH}$$

- b. Load correction into AGC by inserting the following sequence into K148:

VERB 21	NOUN 02	ENTR
01504	ENTR	
SOM444	ENTR	
VERB 21	NOUN 01	ENTR
01505	ENTR	
SMNNNN	ENTR	

6.2.21.5 Start the tape reader.

- 6.2.21.5.1 When the tape reader stops, observe VERB 06, NOUN 61 flashing with R1 displaying gyrocompassing azimuth +77.99 degrees within ± 0.01 degrees.

6.2.21.6 Start the tape reader.

- 6.2.21.6.1 When the tape reader stops, observe VERB 06, NOUN 61 flashing with R1 displaying Nav. Base azimuth, +165.00 within 0.01 degrees and R2 displaying local latitude, +28.516 within 0.006 degrees.

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- 6.2.21.7 Start the tape reader to initiate the Initialization and Inertial Reference portions of the Prelaunch alignment Program. Major Mode will indicate 01.
- 6.2.21.8 Within 10 minutes the MAJOR MODE lights will indicate 02 on the CRT and DSKY when the program enters the gyrocompass portion of the PRE-LAUNCH ALIGNMENT program. At this time, and during each succeeding 15 minute interval for the duration of the test, record in Table 6.1 the dial readings for the Outer Gimbal, Inner Gimbal and Middle Gimbal CDU's. After recording the first (t=0) set of data immediately proceed to step 6.2.21.9.
- 6.2.21.9 Set the CONTROLLER MODE switch to DIRECT, OPTICS MODE switch to ZERO OPTICS, and CONTROLLER SPEED switch to MED on the G&N Indicator Control Panel.
- 6.2.21.10 After the ZERO ENCODER lamp on Event Module 4A3-A4-E1-7 extinguishes set the Optics Mode switch to MANUAL.
- 6.2.21.11 Enter the following inputs into K148:
- VERB 37, ENTER
03, ENTER
- NOTE: The 03 will appear in the MOUN lights when entered. Following the pressing of the ENTER pushbutton, the MOUN lights will be blanked. When the test is entered, 03 will appear in the MAJOR MODE lights within 10 seconds and the KEY RELEASE lamp on the DSKY will illuminate.
- 6.2.21.12 Observe that the Major Mode lights indicate 03 on the CRT.
- 6.2.21.13 Press the KEY RELEASE Pushbutton on the LEB DSKY.
- 6.2.21.14 Perform paragraphs 6.2.20.6 through 6.2.20.11 of the G&N FINE ALIGNMENT TEST, to enter the correct components for TARGETS 1 and 2.
- 6.2.21.15 Observe that the "MARK" command, VERB 51 is flashing on the CRT and DSKY and that the following values are displayed in R1, R2 and R3.

R1	+ 00001	(Target #1)
R2	+ 00002	(Target #2)
R3	+ 00000	

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6.2.21.16 Align the SXT StLOS with the reticle dot on Target #1. When aligned, press the MARK pushbutton.

6.2.21.16.1 If not satisfied with the MARK, enter VERB 52 into K148 or LEB DSKY. Press ENTER pushbutton and repeat step 6.2.21.16. If satisfied with the "MARK" proceed to 6.2.21.17. Observe that VERB 51 continues to flash on CRT and DSKY.

6.2.21.17 Align the SXT StLOS with the reticle dot on Target #2. When aligned, press the MARK pushbutton. Observe 50 in the VERB lights on the CRT and DSKY requesting operator action.

6.2.21.17.1 If not satisfied with this "MARK" reject it by entering VERB 52 into K148 or LEB DSKY. Press ENTER pushbutton and repeat step 6.2.21.17. If satisfied with the "MARK", press the ENTER pushbutton and proceed to 6.2.21.18.

6.2.21.18 Observe the following displays on the CRT and LEB DSKY: (R1, R2 and R3 contain the three misalignment angles).

VERB 06, MOUN 67 (FLASHING)
R1 + XX.XXX (X Gyro Torquing Angle)
R2 + XX.XXX (Y Gyro Torquing Angle)
R3 + XX.XXX (Z Gyro Torquing Angle)

6.2.21.19 Enter the following into K148:

VERB 21 ENTER 00000 X set torq / to 0
VERB 22 ENTER 00000 Y set torq / to 0
VERB 33 ENTER

6.2.21.20 Observe and verify that the MAJOR MODE lights indicate 02 on the CRT and DSKY.

6.2.21.20.1 Wait two (2) hours before proceeding.

6.2.21.21 Repeat steps 6.2.21.9 through 6.2.21.18. Record the readings for the appropriate gyros in Table 6.2. (First Reading, Data Set #2).

6.2.21.21.1 Enter the following inputs into K148:

VERB 34 ENTER

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6.2.21.22 Repeat steps 6.2.21.9 and 6.2.21.18 two (2) more times to obtain the second and third readings. Each time that 6.2.21.18 is completed, record the readings for the appropriate gyros in Table 6.2, and enter the following into K148:

VERB 3* ENTER

6.2.21.22.1 Calculate the average value of the three readings for each gyro and record in Table 6.2.

6.2.21.23 At 30 minute intervals perform steps 6.2.21.23.1 through 6.2.21.23.3 three times to obtain data sets 3 and 4.

6.2.21.23.1 Repeat steps 6.2.21.9 through 6.2.21.18.

6.2.21.23.2 Record the contents of R1, R2 and R3 for the appropriate gyros in Table 6.2.

6.2.21.23.3 Enter the following into K148:

VERB 3* ENTER

6.2.21.24 Calculate the average value of the three readings for each gyro in each data set. Record in Table 6.2.

6.2.21.24.1 The average values recorded in Table 6.2, data sets 2, 3 and 4 shall be:

+ 0.05 degrees or less on X
+ 0.05 degrees or less on Y
+ 0.60 degrees or less on Z

6.2.21.24.2 The average values for data sets 3 and 4 shall not deviate from the average value for data set 2 by more than the following amounts:

+ 0.02 degrees or less than X
+ 0.02 degrees or less than Y
+ 0.08 degrees or less than Z

NOTE: Coordinate the next steps with the test conductor before proceeding.

6.2.21.25 After recording data set 4, have the input voltage to the G&N system adjusted to 26.1 volts dc for a period of one hour.

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6.2.21.25.1 The following lamps on Event Module 4A3A5E1 shall be lighted:

SIGNAL

- a. 28 V DC AGC
- b. 28 V DC OPERATE/IMU
- c. 28V DC OPTICS

6.2.21.25.2 Record voltage readings on the CRT of the following signals on the data sheet:

Measurement

<u>List No.</u>	<u>Signal</u>	<u>Requirement</u>
a. CG 1400	IMU 2.5 V 25.6 KC Supply	2.1 to 2.9 VRMS
b. CG 1401	OFT 2.5 V 25.6 KC Supply	2.1 to 2.9 VRMS
c. CG 1301	IMU 2 V 3200 CPS Supply	2.9 to 4.10 VRMS
d. CG 1101	-28 VDC ELECTRONIC	-33.7 to -21.3 VDC
e. CG 1030	+3 VDC AGC Supply	+1.88 to 4.12 VDC
f. CG 1020	+13 VDC AGC Supply	+11.7 to +14.3 VDC
g. CG 1201	IMU 28 V 800 CPS 1% 0°	27.0 to 29.9 VRMS
h. CG 1203	IMU 28 V 800 CPS 5% 0°	24.7 to 30.3 VRMS
i. CG 1202	IMU 28 V 800 CPS 5% -90°	25.1 to 29.9 VRMS
j. CG 1204	CDU 28 V 800 CPS 5% -90°	26.1 to 29.9 VRMS
k. CG 1211	OPT 28 V 800 CPS 1% 0°	27 to 29 VRMS
l. CG 1212	OPT 28 V 800 CPS 5% -90°	26.1 to 29.9 VRMS

6.2.21.25.3 Repeat steps 6.2.21.23.1 through 6.2.21.23.3 three times thirty minutes after adjustment of the G&N input voltage to 26.1 volts dc.

6.2.21.25.4 Repeat steps 6.2.21.23.1 through 6.2.21.23.3 three times one hour after adjustment of the G&N input voltage to 26.1 volts dc. Record the data as data set 6 in Table 6.2 and calculate and record the average values.

6.2.21.26 Have the input voltage to the G&N system adjusted to 31.3 volts dc for a period of one hour.

6.2.21.26.1 The following lamps on Event Module 4A3A5E1 shall be lighted:

SIGNAL

- a. 28 V DC AGC
- b. 28 V DC OPERATE IMU
- c. 28 V DC OPTICS

6.2.21.26.2 Record the voltage readings for the signals listed in 6.2.21.25.2. The requirements shall be those listed in 6.2.21.25.2.

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6.2.21.26.3 Repeat steps 6.2.21.23.1 through 6.2.21.23.3 three times thirty minutes after adjustment of the G&N input voltage to 31.3 volts dc. Record the data as data set 7 in Table 6.2 and record the average values.

6.2.21.26.4 Repeat steps 6.2.21.23.1 through 6.2.21.23.3 three times one hour after adjustment of the G&N input voltage to 31.3 volts dc. Record the data as data set 8 in Table 6.2 and calculate and record the average values.

6.2.21.27 Have the input voltage to the G&N system adjusted to 28 volts dc.

6.2.21.28 Enter the following into the K148:

VERB 37	ENTR	
00	ENTR	
VERB 40	NOUN 20	ENTR wait 90 seconds
VERB 41	NOUN 20	ENTR
+00000	ENTR	
+00000	ENTR	
+00000	ENTR	

6.2.21.29 Verify that COARSE ALIGN is the only mode lamp lighted on the IMU Control Panel.

6.2.21.30 Pull out OPTICS MN A and MN B breakers on Right Hand Circuit Breaker panel.

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TABLE 6.1

Time Minutes	CDU Dial Readings				MG
	OG	IG	IC		
0					
15					
30					
45					
60					
75					
90					
105					
120					
135					
150					
165					
180					
195					
210					
225					
240					
255					
270					
285					
300					

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TABLE 6.2

Data Set	X Gyro Torquing Angle (R1)	Y Gyro Torquing Angle (R2)	Z Gyro Torquing Angle (R3)
	First Reading	First Reading	First Reading
	Second Reading	Second Reading	Second Reading
	Third Reading	Third Reading	Third Reading
	Average	Average	Average
1			
2 (2 hours)			
3 (2.5 hours)			
4 (3.0 hours)			
5 (Lo Bus)			
6 (Lo Bus)			
7 (Hi Bus)			
8 (Hi Bus)			

APOLLO G&N Specification

NDL002324

Original Issue Date:

Release Authority: TDRR 31027

Class A Release

Post-Installation Checkout Process Specification
For The Apollo Guidance & Navigation System (Spacecraft 14, KSC)

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised

This specification consists of page 1 to/23 inclusive.

APPROVALS

NASA/MSC

ACED

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1. INTRODUCTION

- 1.1 The individual Spacecraft (SC) installed Guidance and Navigation (G&N) System to be checked out per this process specification shall consist of one each of the following major assemblies:

Assembly Name

NAA Drawing No.

Equipment Install-Block I, Series 100
Guidance & Navigation, LWR Equip. Bay

V16-724013

Equip Install - Block I G&N Main
Display Console

V16-724006

- 1.2 The G&N System herein shall be identified as a Block I, Series 100 AGE 121 system and is modified by utilizing a Series 100 computer. The computer contains the SUNSPOT programs in the core rope memory modules.

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2. SCOPE

- 2.1 This specification outlines the checkout requirements for the G&N System installed in the Apollo Command Module, Spacecraft 014 at Kennedy Spacecraft Center, Florida.

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3. APPLICABLE DOCUMENT

3.1 Documents required by this specification.

3.1.1 When the requirements of this specification conflict with the drawing requirements, the drawing requirements shall have precedence.

ATP 1026000	Pre-installation Assembly Test Procedure for the Apollo Guidance and Navigation System, P/W 1015000, Block I), Series 100
FTM 1026000	Final Test Method for G&N System
ICD MH01-01220-216	Interconn Diagram - AGC to AGC Dsk (Main Display Panel)
ICD MH01-01224-416	Attitude Error Signals
ICD MH01-01225-416	Total Attitude Signals
ICD MH01-01226-200	Central Timing Equipment Sync. Pulse
ICD MH01-01227-216	G&N Electrical Input Power
ICD MH01-01228-416	G&N Data Transmission to Operational PCM-Telemetry Equipment
ICD MH01-01236-200	ACE Uplink/SC Digital Up-DATA Link AGC
ICD MH01-01237-216	G&N Hold Attitude
ICD MH01-01242-416	G&N Condition & Display Lights
ICD MH01-01249-416	G&N-Thermal Requirement
SID 63-512	Apollo Command Module/Service Module Measurement Requirements for SC 012/014
MAO201-0499	ACE-S/C Computer Subprogram
MAO201-0831	Program Requirements SC 014
MAO308-0047	Component Installation Procedure - Apollo Guidance Equipment S/C 014

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MA0201-3179	Post Installation Checkout Process Specification for PIPA Scale Factor Determination - Apollo Guidance and Navigation System (Confidential Spec)
MA0610-018A	Contamination Control - Apollo Command Module and Service Module
MA0201-5036	Alignment of Optical Target GSE on Spacecraft
SC 014, Block I, Series 100, AGE	Acceptance Data Package

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4. MATERIAL AND EQUIPMENT

- 4.1 The following test equipment shall be used to perform the requirements of this specification. If protection to personnel and equipment is not decreased, items except government furnished parts, equivalent to those listed may be used.

<u>Item</u>	<u>Quantity</u>	<u>Description</u>
1	1	Carry-on Receiver and Baseplate Unit,
2	1	Carry-on Baseplate Unit, Model No. C14-201
3	1	Junction Box ACE S/C Carry-on, Model No. C14-202
4	1	Carry-on ACE S/C Response System Support Rack, Model No. C14-203
5	1	Support Frame Carry-on DTCS, Model No. C14-204
6	1	Carry-on PCM System, Model No. C14-210
7	1	Digital Signal Conditioner and Multiplexing Unit, Model No. C14-211
8	1	G&W Signal Conditioner and Switching Matrix, Model No. C14-213
9	1	External Digital Test Command Unit, Model No. C14-241
10	1	Data Interleaver System, Model No. C14-232
11	1	S/C Ground Power Supply, Model No. C14-418
12	1	Breakout Box - Test C/M-S/M Adapter, Model No. C14-467
13	1	Electrical Cable Set, Model No. C14-478
14	1	PBA Tray Extender Set 1900806-011, Model No. A23-100
15	1	PBA Test Point Adapter, Model No. A23-167

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<u>Item</u>	<u>Quantity</u>	<u>Description</u>
16	1	Inertial Components Temperature Controller (ICTC) Model No. 823-100
17	1	PBA Adapter Module, Model No. A23-201
18	1	Volt Ohmster Simpson, Model No. 269 or equivalent
19	1	Calculator (Friden or equivalent)
20	1	E-Memory Zeroing Tape No. F04C014-KD0012-00
21	1	Stopwatch
22	1	G&N Polarity Test (System Level Only) F04C014-KD0019-00
23	1	Shorting Plug No. 45A7P2
24	1	Electrical Cable Portable G&N System, Model No. A23-097 C14-462
25	1	Optics Supporting Fixture, Model No. A14-135
26	1	G&N Installation Qualification Fixture, Model No. A23-097
27	1	SCT Resolution Check Card
28	1	DKM-3 Theodolite
29	1	Retroreflecting Prism 1019840, Model No. A23-200
30	1	Movable Optics Target
31	1	Portable Light Assembly (Light Scanning Telescope)
32	1	Electronic Counter with Preset Counter (Hewlett-Packard 5245L with 5264A Preset or equivalent)
33	1	Extender Cable Set
34	1	Flexible Driver TM-62A

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4.1 (Continued)

<u>Item</u>	<u>Quantity</u>	<u>Description</u>
35	1	Hex Head Cap Screwdriver TM AL-5 (5/32 Hex) (or equivalent)
36	1	Carry-on Cable Set C14-574
37	1	AOC Alarms and Interrupts Test Tape, No. F040014-KD0020-00
38	1	Gimbal Friction Test Tape No. F040014-KD0031-00

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5. GENERAL REQUIREMENTS

5.1 Safety Requirements

5.1.1 Operator Safety

5.1.1.1 Normal safety precautions shall be observed throughout the J&M post-installation checkout.

5.1.2 Equipment Safety

5.1.2.1 To preserve the operational life of the components of the G&M hardware under test, settings and adjustments shall be performed only when specified in the test procedure. Care shall be exercised in the accomplishment of all settings and adjustments to avoid excessive wear and damage to the equipment. All precautionary measures stated throughout the test procedures shall be strictly adhered to.

5.1.2.2 Prior to the electrical connection of the G&M System to the spacecraft harness, a complete verification of spacecraft power, to include both voltage polarity and magnitude, shall be completed to preclude damage to the G&M due to incorrect power application.

5.1.2.3 In no event shall the ICTC be disconnected from PSA Tray 7 except when specified to do so in a specific test.

5.1.2.4 The generation of noise alarm indication, as evidenced by one or more Noise Peak Event lamps becoming lighted shall be cause for immediate determination of effects on G&M System Test in progress. In the event of detrimental effects on the system test, a troubleshooting routine shall be entered to determine the cause of the alarm. Testing shall continue only after demonstrating that the cause of the noise alarm has been located and that remedial action has been or will be taken, or that the transient or noise causing the alarm has no detrimental effect on the G&M System test in progress.

5.1.2.5 Failure of the G&M System to pass any examination or test specified herein shall tentatively classify the G&M System as non-conforming. Normal test sequence may be continued upon determination of the cause of the non-conformance or at the discretion of the G&M contractor test team if not detrimental to the G&M System or other interfacing subsystems. All non-conformances shall be investigated and cleared by waiver (F.N.M.), correction of specification, or hardware replacement and retest. The suspected malfunctioned hardware shall be removed and returned to the laboratory where the malfunction shall be verified. Only after malfunction verification shall a flight certified replaceable element be installed in the G&M System.

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5.2 Standard Environmental Conditions

- 5.2.1 The G&N System shall be tested under clean room class 100,000 conditions as specified in process specification MA0610-018A, Contamination Control - Apollo Command Module and Service Module, while installed and operating in the command module.
- 5.2.1.1 For periods of G&N testing with the optical heads and the eyepieces of the SRT and SRT of the C/M G&N uncovered, or with the eyepieces removed, the environment shall meet at least the Class 100,000 specifications for the particle size and count. (No more than 100,000 particles 0.5 microns or larger per cubic foot with no more than 700 particles 5.0 microns or larger per cubic foot).
- 5.2.2 The Apollo G&N System shall interface with a qualified ECS distribution system which shall supply coolant fluid during STANDBY and OPERATE control modes with flow rates and inlet temperatures as specified in ICD ME01-01249-416.

5.3 Test Equipment Tolerances

- 5.3.1 All tolerances specified herein do not include instrumentation uncertainties.

5.4 Test Sequence

- 5.4.1 The Test Sequence normally should follow the steps outlined by Code numbers in Figure I in the order specified. This normal order can be deviated on approval by the G&N Installation Unit, Department 697-506.
- 5.5 After the defective, replaceable element has been substituted with a flight certified unit, the G&N System checkout sequence shall regress to the rerunning of applicable portions of the selected sequence (by paragraph number) categorized by the subassembly in which the malfunction occurred. The chosen subassembly categories are presented in Table II versus an appropriate retest paragraph sequence. Retest shall be conducted by performing applicable portions of all indicated paragraph numbers in the sequence listed as indicated under the appropriate subassembly heading. Retest shall proceed to the point in the normal test sequence at which the discrepancy was detected and corrected. Normal testing shall continue beyond this point in the specified sequence of Table I.
- 5.6 It is assumed that the Test Conductor has a working knowledge of the test equipment used; therefore, this procedure contains only the steps related directly to the G&N System components. If any questions arise concerning the test equipment, the Conductor should refer to the pertinent operational manuals.

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TABLE II. RETEST SEQUENCE

Paragraph Number	DMU	OPTICS	AOC	PSA TRAY 1	PSA TRAY 2	PSA TRAY 3	PSA TRAY 4	PSA TRAY 5	PSA TRAY 6	PSA TRAY 7	PSA TRAY 8	PSA TRAY 9	PSA TRAY 10	G&W DSKY	MCC DSKY	DAC ELEC	SIG COMD	CCDU'S	ICDU'S	G&W HARNESS
6.1.3	X	X																	X	
6.2.1	X	X	X	X				X											X	
6.2.2		X										X	X							
6.2.4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6.2.5				X				X										X		
6.2.3			X		X	X					X	X							X	
6.2.9	X											X	X	X						
6.2.7	X	X	X					X							X					
6.2.10		X	X							X	X	X				X	X			
6.2.11		X								X	X	X					X			
6.2.12		X								X	X	X					X			
6.2.13		X								X	X	X					X			
6.2.14	X		X	X	X	X	X	X	X	X					X			X	X	
6.2.15	X		X	X	X	X	X	X	X					X	X	X			X	X
6.2.16	X		X	X	X				X											
6.2.17	X		X	X	X	X		X	X											
6.2.18	X		X	X	X	X		X	X											
6.2.19	X		X	X	X	X		X	X										X	
6.2.20	X		X	X	X	X		X	X											
6.2.21	X	X	X	X	X	X	X	X	X						X	X				
6.2.8		X																		

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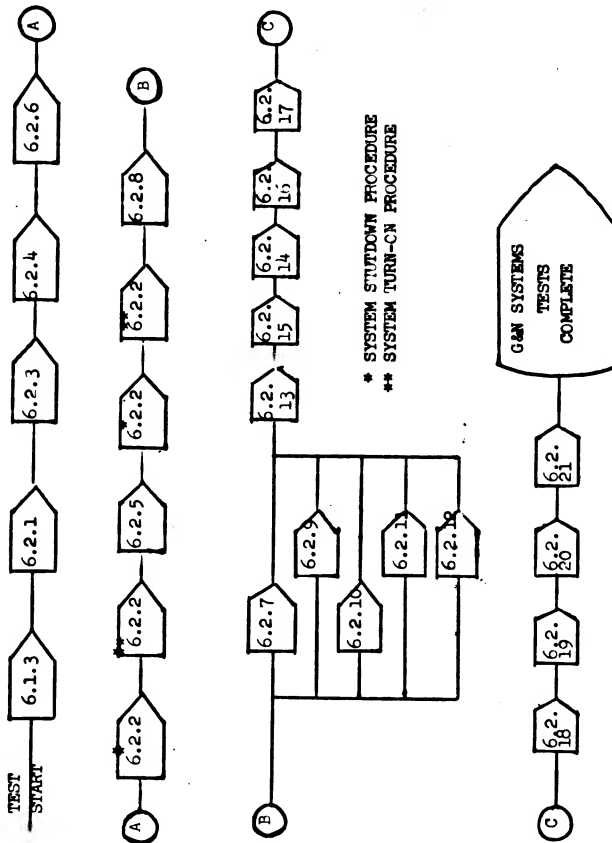


FIGURE 1
CAN INDIVIDUAL SYSTEMS TEST SEQUENCE

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TABLE I.
TEST SEQUENCE

PARAGRAPH NO.	TEST TITLE
6.1.3	Pre-Power Application Tests (Part of G&N Installation OCP)
6.2.1	Application of Standby Power to G&N System
6.2.2	Turn On and Shutdown Procedure
6.2.3	AOC Operational Test
6.2.4	Operate Power On and Power Supply Test
6.2.5	Failure Indicating Circuitry Test
6.2.6	G&N Operational Test
6.2.7	IMU Temperature Control Test
6.2.8	AOC Clock Frequency Test
6.2.9	G&N Panel Brightness and Lamp Test
6.2.10	Zero Optics Test
6.2.11	Optics Slew Rate Test
6.2.12	Optics Coordinate Transformation Control Test
6.2.13	Optics Positional Accuracy Test
6.2.14	Gimbal Friction Test
6.2.15	AOC Mode Control Test
6.2.16	Stabilization Loop Step Response Test
6.2.17	IRIG Scale Factor Test
6.2.18	PIPA Scale Factor Determination Test
6.2.19	IRIG Coefficient Determination Test
6.2.20	Fine Alignment Test EXT-MB-IMU
6.2.21	Gyro Compassing Test

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- 5.7 The following requirements shall be completed before any of the tests in this specification are attempted.
- 5.7.1 The G&N System shall have been qualified in accordance with the requirements of the Pre-installation Assembly Test Procedure for the Apollo Guidance and Navigation System (ATP 1026000).
- 5.7.2 The installation of the G&N System into the spacecraft shall have been completed as specified in process specification MA0308-0047, Mechanical Installation Specification for Apollo Guidance Equipment (S/C 014).
- 5.7.3 All ACE equipment shall have been qualified in accordance with the respective quality assurance specifications prior to use with the G&N System.
- 5.8 The following conditions are required for testing the G&N System.
- 5.8.1 Spacecraft systems other than the G&N System may be operating on a non-interfering basis while individual system checkout of the G&N System is being conducted.
- 5.8.2 The G&N System shall be supported by the Electrical Power System and Environment Control System during operation in the Command Module. The Stabilization and Control System shall be connected to the G&N System during G&N operation in the Command Module for passive loading purposes if available.
- 5.8.3 During tests which interface with the Stabilization and Control System and the Central Timing System, operation of these systems shall be required.
- 5.9 The G&N System shall be tested per this specification after it is installed in the spacecraft. In the event that the installed system, or any assembly thereof, is removed from the spacecraft for modification, recycle, or any other reason, this process specification or pertinent portions of it shall be performed after the G&N System, or assembly thereof, is reinstalled. Testing shall be limited to G&N System operation while actively connected to qualified spacecraft threshold systems, namely, the Electrical Power System (EPS), Environmental Control System (ECS), and Communications and Instrumentation System (C&IS) as much as possible. However, a minimum of combined and integrated system testing with the Stabilization and Control System (SCS), Central Timing System (CTS) and Caution and Warning System is required for complete G&N System verification.

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5.10.3 Miscellaneous hardware required in support of G&N testing consists of the following:

a. Movable Optics Target

5.11 Data Record

5.11.1 All data concerning the checkout and operation of the G&N System as monitored via ACE, shall be recorded on the data sheets associated with their corresponding test. Out-of-tolerance readings shall be recorded and flagged by appropriate symbols to attention.

5.11.1.1 Test Data. All test data obtained while demonstrating the requirements of this document shall permanently be recorded and forwarded with the tested G&N to the next receiving agency.

5.11.1.2 An authorized Quality Control Representative shall monitor this test and verify compliance to this specification by signing or stamping applicable documents including all test data recorded. (Form 962-F or equivalent).

5.11.2 The PCM Raw Data magnetic tape recorder shall be turned on at all times while any portion of the G&N is operating.

5.11.3 The Event Recorder, 4A2-A2, shall be turned on at all times while any portion of the G&N System is operating.

5.12 Interface

5.12.1 The APOLLO G&N System shall interface with accepted ECS and EPS distribution systems for power and environment control purposes and with the ECS or SC8 substitute system for signal interface according to the ICD's listed below.

- | | |
|------------------------------|---|
| a. ICM MH01-01220-216 | Interconn Diagram-AGC to AGC DSKY
(Main Display Panel) |
| b. ICD MH01-01224-416 | Attitude Error Signals |
| c. ICD MH01-01225-416 | Total Attitude Signal |
| d. ICD MH01-01226-200 | Central Timing Equipment Sync. Pulse |
| e. ICD MH01-01227-216 | G&N-Electrical Input Power |
| f. ICD MH01-01228-416 | G&N Data Transmission to Operational
PCM-Telemetry Equipment |
| g. ICD MH01-01236-200 | ACE Uplink, SC Digital Up-Data Link AGC |
| h. ICD MH01-01237-216 | G&N-Hold Attitude |
| i. ICD MH01-01242-416 | G&N Condition & Display Lights |
| j. ICD MH01-01249-416 | G&N-Thermal Requirements |

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5.10 The procedure accomplished and the requirements listed herein are verified through the use of Acceptance Checkout Equipment - Spacecraft (ACE-S/C). The Ground Support Equipment (GSE) shall be augmented by the following list of signal conditioning carry-on equipment. This equipment must be connected and ready for operation before the test of this specification is initiated.

- a. Carry-on PCM System, Model No. C14-210
- b. Digital Signal Conditioner and Multiplexing Unit, Model No. C14-211
- c. G&N Signal Conditioner and Switching Matrix, Model No. C14-213
- d. Carry-on Receiver and Baseplate, Model No. C14-200
- e. Carry-on Baseplate Unit, Model No. C14-201
- f. Junction Box ACE-S/C Carry-on, Model No. C14-202
- g. Carry-on ACE-S/C Response System Support Rack, Model No. C14-203
- h. Support Frame Carry-on DTCS, Model No. C14-204

5.10.1 Ground Support Equipment (GSE) carry-on gear in support of the signal conditioning carry-on gear shall consist of the following:

- a. Electrical Cable Set, Model No. C14-178
- b. PSA Test Point Adapter, Model No. A23-167
- c. Breakout Box - Test C/M-S/M Adapter, Model No. C14-467
- d. Volt Ohmmeter Simpson Model No. 269 or equivalent

5.10.2 Ground Support Equipment (GSE) required for performing other selected G&N tests consists of the following:

- a. Volt Ohmmeter, Simpson Model No. 269 or equivalent
- b. Optics Support Fixture, Model No. A14-135
- c. G&N Installation Qualification Fixture, Model No. A23-071
- d. Azimuth Reference Fixture, Model No. A23-096
- e. Theodolite (JBM3 or equiv.) Model No. A23-079
- f. Retroreflecting Prism 1019840 Model No. A23-200
- g. Portable Light Assembly (SCT lamp)

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5.13 Optics Power Turn On Procedure for Optical GSE Alignment Test

5.13.1 The Optical GSE Subsystem Alignment Test must be completed before proceeding with the following tests:

- a. 6.2.13 Optic Positional Accuracy Test
- b. 6.2.20 Fine Alignment Test
- c. 6.2.21 Gyro Compassing Test
- d. 6.2.18 PIPA Scale Factor Determination Test

5.13.2 The G&N Optics Turn On procedure for Optical GSE Subsystem Alignment Test may be performed at anytime in the tests in Table I, Test Code No. 2 through 11, except for those sequences requiring OPTICS or VIEWER main power shutdown.

5.13.3 G&N Optics Power Turn-ON

5.13.3.1 Insure that the SXT and SCT eyepieces are installed properly on the G&N optics base. The optics switches and selectors on the G&N Indicator Control Panel shall be set to the following positions:

- a. SLAVE TELESCOPE to STAR LOS
- b. OPTICS MODE to ZERO OPTICS
- c. CONTROLLER MODE to DIRECT
- d. CONTROLLER SPEED to LO
- e. POWER and BRIGHTNESS to ON
- f. PANEL BRIGHTNESS to maximum increase

5.13.3.2 Place or verify that the VIEWER AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON position. (Breakers pushed in).

5.13.3.3 Place the OPTICS MNA and MNB breakers on the Right Hand Circuit Breaker Panel to ON position. (Breakers pushed in).

5.13.3.4 Verify that the ZERO ENCODER on the Condition Annunciator Panel is lighted for no more than 90 seconds after optics power turn on.

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- 5.13.3.5 OPTICS +28 VDC DISCRETE shall be issued (CG1533) by observing that the OPTICS lamp on the Event Module is lighted.
- 5.13.3.6 Sight through the EXT eyepiece to verify that the optical reticles are illuminated.
- 5.13.3.7 Verify that the optics supply voltage listed below appear on the CRT:
- a. CG 1401 OPTX 2V 25.6 MC Supply in PH +2.1 to 2.9 VRMS
 - b. CG 1211 OPTX 28V .8 MC 14 DEG supply +27 to 29 VRMS
 - c. CG 1212 OPTX 28V .8 MC 54-90 supply +26.1 to 29.9 VRMS
- 5.13.3.8 Verify the 2X TRUNNION and SHAFT Angles on the CDU panel display 000.000 ± 0.100 degrees.
- 5.13.3.9 Ensure that the optics GSE, Optics Support Fixture, Model No. A14-135, has been properly installed.
- 5.13.3.10 Proceed with the Optical GSE Subsystem Alignment Test in accordance with MAQ201-5036.
- 5.14 There are requirements in 6.2.7 IMU Temperature Control Test, 6.2.18 PIPA Scale Factor Determination Test, and 6.2.19 IRIG Coefficient Determination Test that must be obtained from the Acceptance Data Package. The aforementioned data, which fulfilled the requirements, shall be available prior to checkout of the G&N System.

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6. DETAIL REQUIREMENTS

6.1 Initial Test Conditions

6.1.1 The following precautions shall be observed to preclude loss of continuity in inertial component performance history of the IMU. Deviation may necessitate recalibration of the inertial components.

6.1.1.1 The IMU shall be supplied with heater power on a continuous basis unless otherwise specified. When S/C Ground Power Supply, Model No. C14-418 is not providing heater power, then heater power shall be supplied through the Inertial Components Temperature Controller (ICTC) Model No. S23-100. The temperature of the inertial components shall not drop below 120°F while under control of the ICTC.

6.1.1.2 The Standby Mode is identified by the circuit breakers IMU HTR MN A, IMU HTR MN B, COMPUTER MN A and COMPUTER MN B in the ON position and IMU MN A and MN B in the OFF position. The Operate Mode is identified by the circuit breaker IMU HTR MN A, IMU HTR MN B, COMPUTER MN A, COMPUTER MN B, the Computer Mode Control (CMC) switch to the ON position, and IMU MN A and IMU MN B in the ON position. The G&N System shall be operating in the Standby Mode (with CMC power ON) for a minimum of two hours prior to advancing to the IMU Operate Mode. In the event Standby Mode power is interrupted, an equivalent time period shall be allowed when power is restored before advancing to the Operate Mode, except that when the interval of interruption exceeds two hours, a two-hour warm-up period shall be mandatory.

6.1.1.2.1 After 6.2.4.6.3 and 6.2.2.1 have been performed and it is known that the spacecraft or IMU have not been moved, and that the shutdown period did not exceed 5 days, it is permissible to enter the IMU Operate Mode after the system has been in the Standby mode for a minimum of 90 seconds.

6.1.1.3 The Inertial Measurement Unit shall not be without Heater power for a period greater than 15 minutes.

6.1.1.4 During the turn on the G&N power, the COMPUTER MN A, COMPUTER MN B, IMU HTR MN A and IMU HTR MN B circuit breakers must be turned on before the IMU MN A and IMU MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. During the turn off of the G&N power, the IMU MN A and IMU B circuit breakers must be turned off before the IMU HTR MN A and IMU HTR MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM.

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- 6.1.1.5 A warm-up period of one hour with OPERATE power applied shall be required prior to performing any test in which gyro or accelerometer parameters are measured, and a 15 minute warm-up period to any test in which precision amplitude and frequency power supply checks are made.
- 6.1.1.6 The AGC Mode switch shall never be in the STANDBY position when Operate Power is supplied to the G&N System.
- 6.1.1.7 Remove Operate power if any of the following situations occur as indicated by observing the gimbal resolvers total attitude signals displayed on ACE meters. (CG2112 IGA 1X RES OUTPUT SINE IN PHASE, CG 2113 IGA 1X RES OUTPUT COS IN PHASE, CG 2142 MGA 1X RES OUTPUT SINE IN PHASE 2143 MGA 1X RES OUTPUT COS IN PHASE, CG 2172 OGA 1X RES OUTPUT SINE IN PHASE, and CG 2173 OGA 1X RES OUTPUT COS IN PHASE.
- The gimbals do not stop moving within 15 seconds after first applying operate power while in coarse align.
 - The gimbals do not stop moving within 5-6 seconds after the IMU delay light goes out or when changing from coarse align to fine align attitude control or entry.
 - The gimbals do not stop moving with 5-6 seconds after inserting or removing the step Response Test input.
- 6.1.2 The UPTL switch on the MDC AGC DSKY Panel No. 14 shall remain in the ACCEPT Position except when otherwise specified as procedural function.
- 6.1.2.1 In no case shall the MARK REJECT button be pressed on the G&N Indicator Control Panel.

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TABLE III. RESISTANCE REQUIREMENTS OF SC/G&N POWER

Test Number	Ground	From	To	Requirements	
1	OVDC IMU	56P11-D	56P11-L	5.0 mega	to infinity
2	OVDC IMU	56P11-D	56P11-G	1000.0 ohms	to infinity
3	OVDC IMU	56P11-D	56P11-J	1000.0 ohms	to infinity
4	OVDC IMU	56P11-D	56P11-K	5.0 mega	to infinity
5	OVDC IMU	56P11-D	56P11-E	0.0 ohms	to 0.5 ohms
6	OVDC IMU	56P11-D	56P11-F	0.0 ohms	to 0.5 ohms
7	OVDC IMU	56P11-D	56P12-D	0.0 ohms	to 0.5 ohms
8	OVDC Optics	56P11-G	56P12-G	0.0 ohms	to 0.5 ohms
9	OVDC AGC	56P11-J	56P12-J	0.0 ohms	to 0.5 ohms
10	Structure Grd	56P11-L	56P12-L	0.0 ohms	to 0.5 ohms
11	OVDC IMU	56P11-E	56P12-F	0.0 ohms	to 0.5 ohms
12	OVDC IMU	56P11-F	56P12-F	0.0 ohms	to 0.5 ohms
13	OVDC Optics	56P11-E	56P11-L	5.0 mega	to infinity
14	OVDC AGC	56P11-J	56P11-G	5.0 mega	to infinity
15	OVDC AGC	56P11-J	56P11-L	5.0 mega	to infinity
16	400-115V	56P11-K	56P11-L	5.0 mega	to infinity
17	400-115V	56P11-K	56P11-G	5.0 mega	to infinity
18	500-115V	56P11-K	56P11-J	5.0 mega	to infinity

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6.1.3 Pre-Power Application Requirements

CAUTION

Ensure that the power connection from the Inertial Component Temperature Controller or PTC is connected and remains connected to PBA TRAY 7 front panel connector, 45A7J2.

- 6.1.3.1 Prior to connecting G&N power connector 56P11 and 56P12 to spacecraft power connectors C27-1A16-J190 and C27-1A16-J191 respectively, it is necessary to perform a complete verification of spacecraft power.
- 6.1.3.2 Ensure that G&N connectors 56P9, 05A3J2 and 45A1J1 through 45A10J1 are disconnected from their mating connectors.
- 6.1.3.3 Ensure that the circuit breakers as listed in Table V on the S/C Right Hand Circuit Breaker Panel are in the OPEN position. (Breakers pulled out.)
- 6.1.3.4 Obtain Extender Cable Set and insert connectors to G&N Connector 56P11 and 56P12, located at the lower rear portion of the Right Hand Support Panel.
- 6.1.3.5 Using a volt ohmmeter (4.1, Item 18), the resistance between the pins shall be as follows in Tables III and IV.

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TABLE IV. RESISTANCE REQUIREMENTS ON G&W POWER CONNECTORS

Test Number	From	To	Requirements	Test Results
1	56P11-A	56P11-J	2.4 ohms to infinity	
2	56P11-B	56P11-D	2.4 ohms to infinity	
3	56P11-C	56P11-D	2.4 ohms to infinity	
4	56P11-E	56P11-G	7.7 ohms to infinity	
5	56P11-M	56P11-D	11.8 ohms to infinity	
6	56P11-N	56P11-K	2.0 ohms to infinity	
7	56P12-A	56P12-J	2.4 ohms to infinity	
8	56P12-B	56P12-D	2.4 ohms to infinity	
9	56P12-C	56P12-D	2.4 ohms to infinity	
10	56P12-E	56P12-G	7.7 ohms to infinity	
11	56P12-M	56P12-D	11.8 ohms to infinity	

6.1.3.6 Disconnect connector 56P11 and 56P12 from the Extender Cable Set connector.

6.1.3.7 Insert connectors of Extender Cable set spacecraft power connectors C27-1A16-J190 and C27-1A16-J191.

6.1.3.8 Polarity and Voltage Check on SC/G&W Power

6.1.3.8.1 The following circuit breakers on the Right Hand Circuit Breaker Panel, as listed in Table V, shall be closed (breakers pushed in) and the voltage across the pins at specified SC connectors shall be within its requirements.

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TABLE V. POLARITY AND VOLTAGE REQUIREMENTS ON SC/G&N POWER

Test Number	Subsystem Circuit Breakers	Polarity and Connector Pin No.		Requirements
		Low	High	
1	COMPUTER MW A	C27-1A16J-190-J	C27-1A16J-190-A	+27.3 \pm 2.5 VDC
2	OPTICS MW A	C27-1A16J-190-G	C27-1A16J-190-H	+27.3 \pm 2.5 VDC
3	IMU MW A	C27-1A16J-190-D, E, F	C27-1A16J-190-B, C	+27.3 \pm 2.5 VDC
4	IMU HTR MW A	C27-1A16J-190-F	C27-1A16J-190-M	+27.3 \pm 2.5 VDC
5	COMPUTER MW B	C27-1A16J-191-J	C27-1A16J-191-A	+27.3 \pm 2.5 VDC
6	OPTICS MW B	C27-1A16J-191-G	C27-1A16J-191-H	+27.3 \pm 2.5 VDC
7	IMU MW B	C27-1A16J-191-D, E	C27-1A16J-191-B, C	+27.3 \pm 2.5 VDC
8	IMU HTR B	C27-1A16J-191-F	C27-1A16J-191-M	+27.3 \pm 2.5 VDC
9	VIEWER AC 1	C27-1A16J-190-K	C27-1A16J-190-N	115 \pm 10 VAC
10	VIEWER AC 2	C27-1A16J-190-K	C27-1A16J-190-N	115 \pm 10 VAC

- 6.1.3.8.2 Open the circuit breakers as listed in Table V on the S/C Right Hand Circuit Breaker Panel (breakers pulled out).
- 6.1.3.8.3 Demate Extended Cable Set from spacecraft power connector C27-1A16-J190 and C27-1A16-J191.
- 6.1.3.8.4 Mate connector 56P11 to connector C27-1A16-J190.
- 6.1.3.8.5 Mate connector 56P12 to connector C27-1A16-J191.
- 6.1.3.8.6 Mate connector 56P9 to connector 30A1J1 (G&N Signal Conditioner).

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6.2 Test Procedures

6.2.1 Application of Standby Power to G&N System

NOTE: Alarm and fail indications may occur in 6.2.1.6.1 and 6.2.1.8.2, while performing this test. Reset alarm by pressing the SYSTEM RESET pushbutton on the ICTC.

- 6.2.1.1 Verify that spacecraft power checks, to include polarity and magnitude on Spacecraft Power Connector, have been made as specified in 6.1.3.
- 6.2.1.2 All power and control switches on the G&N Indicator and Display Panel shall be placed in the OFF or neutral position.
- 6.2.1.3 The Inertial Component Temperature Controller (ICTC) Model No. 823-100, shall be supplying inertial component heater power to the G&N System through Tray No. 7 front panel connector 45A7J2.
- 6.2.1.4 Computer Power On
 - 6.2.1.4.1 Set the AGC MODE switch to ON position. Switch shall remain in the ON position unless specified otherwise as a procedural step.
 - 6.2.1.4.2 Set G&N COMPUTER MW A and MW B breakers on the Right Hand Circuit Breaker Panel to ON position (breakers pushed in). Record the value of CG 1520, AGC +28V on the CRT (24.5 V to 30.5V).
 - 6.2.1.4.3 Set the VIEWER AC 1 and AC 2 breakers on the Right Hand Circuit Breaker Panel to ON position (breakers pushed in).
 - 6.2.1.4.4 Set the computer numerical display lights to the desired brightness by rotating the BRIGHTNESS thumbwheel on the LEB AGC DESKY and MDC AGC DESKY.
 - 6.2.1.4.5 The AGC +28 VDC power discrete shall be issued (CG1523). This can be observed by the lighted AGC +28 VDC operate lamp on the Event Module.
 - 6.2.1.4.6 Ignore the computer alarm lights on the AGC DESKY panels. Enter VERN 36 in K 148. Press ENTER pushbutton. Press ERROR RESET pushbutton. All computer alarms on the Main Display Console (MDC) and LEB AGC DESKY shall clear.
 - 6.2.1.4.7 The voltage output of the +3 VDC AGC supply shall be +1.66 to +4.12 VDC, CG 1030. The value on CRT shall be recorded.
 - 6.2.1.4.8 The voltage output of the +13 VDC AGC supply shall be +11.7 to 14.3 VDC, CG 1020. The value on CRT shall be recorded.

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6.2.1.4.9 Verify that the AGC is in the Backup Mode by monitoring on CRT that the Program indicates 00, and the program readouts on the MDC and LEB AGC DSKY indicate 00.

6.2.1.4.10 Reset MASTER ALARM by pressing the MASTER ALARM LAMP.

6.2.1.4.11 Perform the following sequences on the LEB DSKY:

- a. Insert VERB 22, NOUN 02, Enter
- b. Insert 00041, Enter
- c. Insert 00000, Enter

6.2.1.4.12 Obtain E Memory Zeroing Tape No. F040014-K00012-00 and load the tape into the tape reader. Run the tape to the first STOP on the tape to zero erasable AGC memory locations, and load the tape to the next STOP on the tape to zero erasable AGC memory locations.

6.2.1.4.13 Run the remaining portion of tape to initiate AGC Self Test. Wait approximately three minutes.

6.2.1.4.13.1 R1, R2, and R3 of DSKY will display contents of SCOUNT, SCOUNT+1 and SCOUNT+2 registers, respectively. Verify R1, R2, and R3 are incrementing in a positive direction every 67 + 2 seconds. Monitor R1, R2, and R3 until R1 equals 00003, and R2 and R3 equal 00002.

6.2.1.5 IMU HTR Heater Power on and Shorting Plug Verification

NOTE: 6.2.1.5.1 through 6.2.1.5.2 must be completed as quickly as possible. Under no condition should the elapsed time be greater than 15 minutes.

6.2.1.5.1 Remove all power to the ICTC. Remove the ICTC cable connected to connector 45A7J2 on Tray 7 of the PSA. Install the shorting plug 45A7P2.

6.2.1.5.2 Enter the IMU Standby Mode of operation by engaging the IMU HTR MN A and MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in). Record range time.

6.2.1.5.3 Verify that the IMU +28 VDC STANDBY discrete lamp on Event Module is lighted. (CG 1513)

6.2.1.5.4 Set ICTC Power ON-OFF switch to ON position.

NOTE: The alarm bells will ring during the following procedures until the PTC OFF ALARM RESET is pressed in.

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- 6.2.1.5.5 Remove 115 VAC from the Battery Power Pack.
- 6.2.1.5.6 Press the 115 V LINE/115V OFF ALARM RESET pushbutton.
- 6.2.1.5.7 Press the PTC OPERATING/PTC OFF ALARM RESET pushbutton.
- 6.2.1.5.8 Press the EMERGENCY pushbutton on the Battery Power Pack.
- 6.2.1.5.9 Verify that the BATTERY IN USE lamp is lighted on the Battery Power Pack.
- 6.2.1.5.10 Record the value of the following signals displayed on CRT:

Signal	Requirement
a. CG1301 2V 3200 CPS POWER SUPPLY	+2.8 to +4.2
b. CG1510 + 28 VDC STANDBY POWER	25.8 to 30.8 VDC
c. CG1511 +28 VDC STANDBY NOISE	0 to +0.7 VRMS

- 6.2.1.5.11 The IRIG TEMP and IMU HEATER CURRENT on CRT shall be monitored periodically for one hour to ensure that the IRIG Temperature Control Loop circuitry is operating to maintain a temperature of 128.0°F to 134.5°F and current of 0.75 to 1.60 amperes (when current is applied) (CG2301) (2302).
- 6.2.1.5.12 The PIPA TEMP shall be monitored on CRT periodically for one hour to ensure that the PIPA Temperature Control Loop circuitry is operating to maintain a temperature of 128.0°F to 134.5°F (CG2300). (To be completed concurrently with 6.2.1.5.11).
- 6.2.1.5.13 The G&N System shall be in the Standby Mode for a minimum of one hour before proceeding with 6.2.1.6, Temperature Control Loop Tests. The test of 6.2.3, AGC Operation Test, may be performed during this period.
- 6.2.1.6 Temperature Control Loop Tests
 - 6.2.1.6.1 Verify that the IMU TEMP MODE switch on the G&N Indicator Control Panel is set to AUTO OVERRIDE Position.
 - 6.2.1.6.2 IRIG Temperature Bridge Calibration Test.

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6.2.1.6.2.1 Press and hold ZERO pushbutton on the G&N Indicator Control Panel.

6.2.1.6.2.2 IRIQ Temperature Indicating Bridge Amplifier output shall be 132.9°F to 134.1°F (CG2301). Record indication of IRIQ TEMP as displayed on CRT.

6.2.1.6.2.3 Release ZERO pushbutton. The IRIQ Temperature Indication Bridge Amplifier output shall be 128.0°F to 134.5°F (CG2301). Record as displayed on CRT of IRIQ TEMP meter on Meter Module.

6.2.1.6.3 IRIQ Temperature Bridge Gain Test

6.2.1.6.3.1 Press and hold IRIQ GAIN pushbutton on G&N Indicator Control Panel. The IMU TEMP condition lamp shall be lighted.

6.2.1.6.3.2 The IRIQ Temperature Indicating Bridge Amplifier output shall be 127.9°F to 129.1°F (CG2301). Record indication of IRIQ TEMP as displayed on CRT.

6.2.1.6.4 PIPA Temperature Bridge Calibration Test

6.2.1.6.4.1 Press and hold ZERO pushbutton on the G&N Indicator Control Panel.

6.2.1.6.4.2 The PIPA Temperature Indicating Bridge Amplifier output shall be 129.4°F to 130.6°F (CG2300). Record indication of PIPA TEMP as displayed on CRT.

6.2.1.6.5 PIPA Temperature Bridge Gain Test

6.2.1.6.5.1 Press and hold PIPA GAIN pushbutton on G&N Indicator Control Panel, and record indication on PIPA TEMP as displayed on CRT (CG2300).

6.2.1.6.5.2 IMU TEMP condition lamp shall be lighted.

6.2.1.6.5.3 The PIPA Temperature Indicating Bridge Amplifier output shall be 134.4°F to 135.6°F.

6.2.1.6.5.4 Release PIPA GAIN pushbutton, and record indication of PIPA TEMP as displayed on CRT (CG2300).

6.2.1.6.5.5 IMU TEMP condition shall not be lighted.

6.2.1.6.5.6 The PIPA Temperature Indicating Bridge Amplifier output shall be 128.0°F to 134.5°F.

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6.2.1.7 Temperature Control Using the ICTC and the Removal of Shorting Plug

NOTE: 6.2.1.7.1 through 6.2.1.7.3 must be completed in less than 15 minutes.

- 6.2.1.7.1 Remove standby power by opening the IMU HTR breakers MN A and MN B on the Right Hand Circuit Breaker Panel (breaker pulled out). The +28 VDC STANDBY lamp on Event Module shall not be lighted (CG 1513).
- 6.2.1.7.2 Remove shorting plug 45ATP2 from connector 45ATJ2 on PBA Tray 7. Install the cable from the PTC/ICTC to this connector.
- 6.2.1.7.3 Apply 115 VAC to the Battery Power Pack.
- 6.2.1.7.4 Press the 115 V LINE/115 V OFF ALARM RESET pushbutton.
- 6.2.1.7.5 Press the PTC OPERATING/PTC OFF ALARM RESET pushbutton on the Battery Power Pack.
- 6.2.1.7.6 Verify that the 115V LINE power lamp and the PTC power lamp are lighted.
- 6.2.1.7.7 Verify PTC OFF ALARM RESET lamp is not lighted.
- 6.2.1.7.8 Verify temperature on ICTC Temperature Meter is $135 \pm 5^{\circ}\text{F}$.
- 6.2.1.7.9 Verify current reading on ICTC Current Meter is 1.0 ± 0.75 amps.
- 6.2.1.7.10 Enter Standby Mode of operation by engaging the IMU HTR MNA and MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in). Reset ICTC alarm, if it is turned on.
- 6.2.1.7.11 Verify presence of the +28 VDC IMU STANDBY discrete (CG1513) by noting that the +28 VDC STANDBY discrete lamp on Event Module is lighted.
- 6.2.1.7.12 After a minimum of two hours in the Standby Mode, the following temperatures and current shall be recorded.
 - 6.2.1.7.12.1 Record the IRIG and PIPA temperatures as displayed on CRT. (CG2301, CG2300).
 - 6.2.1.7.12.1.1 The IRIG Temperature shall be 128.6°F to 138.3°F (CG2301).
 - 6.2.1.7.12.1.2 The PIPA Temperature shall be 125.1°F to 134.8°F (CG2300).
 - 6.2.1.7.12.2 Record the IMU Heater current as displayed on CRT.
 - 6.2.1.7.12.2.1 The Heater current shall be 0.75 to 1.60 amperes (CG2302). (only when current is applied).

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6.2.2 General Turn Off and Turn On Procedure

NOTE: This procedure shall be utilized any time after performing 6.1.3 Pre-power Application Requirements, 6.2.1, Standby Power On Test, and 6.2.4, Operate Power On Test, to turn on or turn off the G&N System. Appropriate portions of this procedure will be referenced in other tests.

6.2.2.1 Turn OFF Procedure

CAUTION

This procedure must be followed in the order specified. Failure to adhere to this procedure may require recalibration of the inertial components.

6.2.2.1.1 Verify or place the TRANSFER switch on the IMU CONTROL Panel to the COMPUTER position.

6.2.2.1.2 Enter the following values into KI48 in the listed sequence:

- a. Insert VERB 41 HOUR 20 and verify. Press the ENTER pushbutton.
- b. Insert +00000 and verify. Press the ENTER pushbutton.
- c. Insert -05700 and verify. Press the ENTER pushbutton.
- d. Insert +09000 and verify. Press the ENTER pushbutton.

6.2.2.1.3 Verify that the COARSE ALIGN MODE lamp on the IMU CONTROL panel is the only MODE lamp that is lighted. Wait 60 seconds.

6.2.2.1.4 Place the TRANSFER Switch on the IMU CONTROL to the MANUAL position.

6.2.2.1.5 Set the following switches on the G&N Indicator Control Panel to the positions designated.

- a. SLAVE TELESCOPE to STAR LOS
- b. OPTICS MODE to ZERO OPTICS
- c. CONTROLLER MODE to DIRECT
- d. CONTROLLER SPEED to LO
- e. POWER AND BRIGHTNESS to OFF
- f. ATTITUDE IMPULSE ENABLE to OFF
- g. IMU TEMP MODE to AUTO-OVERRIDE

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- 6.2.2.1.6 Set the G&N OPTICS MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OPEN position (breakers pulled out).
- 6.2.2.1.7 Set the G&N IMU, MHA and MN B breakers on the Right Hand Circuit Breaker Panel to OPEN position (breakers pulled out).
- 6.2.2.1.8 The BRIGHTNESS thumbwheel on AGC-DSKY-LES (lower Equipment Bay) and AGC DSKY-MDC (Main Display Console) shall be decreased to its minimum brightness - OFF position.
- 6.2.2.1.10 Set the G&N COMPUTER MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF position (breakers pulled out).
- 6.2.2.1.11 Set the G&N VIEWER AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to OFF position (breakers pulled out).
- 6.2.2.1.12 Set ICTIC POWER ON-OFF switch to ON. Press ALARM RESET switch and verify ALARM RESET lamp is not lighted. Verify that the ICTIC is supplying inertial component heater power to the G&N System as indicated by the PTC HEATER POWER lamp illuminated on the PTC. Verify the temperature is within $135 \pm 5.0^\circ$ and the current is within 1 ± 0.75 amperes on the PTC meter.
- 6.2.2.2 Turn On Procedures
 - 6.2.2.2.1 Set or verify the following switches on the G&N Indicator Control Panel to the positions designated.
 - a. SLAVE TELESCOPE to STAR LOS
 - b. OPTICS MODE to ZERO OPTICS
 - c. CONTROLLER MODE to DIRECT
 - d. CONTROLLER SPEED to LO
 - e. POWER AND BRIGHTNESS to OFF
 - f. ATTITUDE IMPULSE ENABLE TO OFF
 - g. IMU TEMP MODE to AUTO OVERRIDE
 - 6.2.2.2.2 Ensure that SYNC switch on the MDC Panel 25 is in the OFF position.
 - 6.2.2.2.3 Ensure that interfacing systems EPS and ECS are turned on and operating properly.

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- 6.2.2.2.4 Ensure that the TRANSFER switch on the IMU CONTROL panel is set to MANUAL position.

CAUTION

The remaining procedure must be followed in the order specified. Failure to adhere to this procedure may require recalibration of the inertial components.

- 6.2.2.2.5 Energize the G&N VIEWER AC 1 and AC 2 breakers on the Right Hand Circuit Breaker panel (breakers pushed in).
- 6.2.2.2.6 Ensure that the AGC MODE switch is set to ON position.
- 6.2.2.2.7 Energize the G&N COMPUTER MW A and MW B breakers on the Right Hand Circuit Breaker panel (breakers pushed in). Ensure that the AGC +28 VDC discrete lamp on Event Module is lighted (CG 1523). Verify that the secondary AGC power supply voltages on the CRT, display the following requirements:
- a. CG 1020 +13 VDC AGC Supply +11.7 to +14.3 VDC
 - b. CG 1030 + 3 VDC AGC Supply +1.88 to +4.12 VDC
- 6.2.2.2.8 Disregard all alarm indications on the AGC DSKY panels. Enter VERB 36 into K148. Press ENTER pushbutton. Press ERROR RESET pushbutton. All computer alarms on the Main Display Console (MDC) and LEB AGC DSKY shall clear. Verify register R1, R2, and R3 on the AGC DSKY's are cleared.
- 6.2.2.2.9 Set the computer display lights to the desired brightness by rotating the BRIGHTNESS thumbwheels on the LEB AGC DSKY and MDC AGC DSKY.
- 6.2.2.2.10 On G&N Facility Interface Box, set the switch to FIRE ALARM BY-PASS Position.
- 6.2.2.2.11 Energize the G&N IMU HTR MW A and MW B breakers on the Right Hand Circuit Breaker panel (breakers pushed in).
- 6.2.2.2.12 Verify that the IMU +28 VDC STANDBY discrete lamp on Event Module is lighted (CG 1513).
- 6.2.2.2.13 Reset ICTC alarm if alarm indication is present. Reset ICTC alarm. Verify ICTC ON/OFF switch to ON position.
- 6.2.2.2.14 Perform the following sequences on the LEB DSKY:
- a. Insert VERB 21, MOUN 01, ENTER
 - b. Insert 00041, ENTER
 - c. Insert 00000, ENTER

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6.2.2.2.15 Obtain E. Memory Zeroing Tape No. FO4C014-K00012-00 and load tape into the tape reader. Run the tape to the first STOP on the tape to zero erasable AOC memory locations.

6.2.2.2.16 Run the remaining portion of Tape No. FO4C014-K00012-00 to initiate AOC Self Test. Wait approximately three minutes.

6.2.2.2.16.1 Verify FAILURE DETECT lamp on Event Module 4A3 is not lighted.

6.2.2.2.16.2 Verify G&N ERROR lamp on MDC Panel 10 is not lighted.

NOTE: Anytime when VERB 36 is entered G&N ERROR lamp on MDC Panel No. 10 and FAILURE DETECT lamp on Event Module 4A3 will light.

6.2.2.2.16.3 R1, R2, and R3 of DSKY will display contents of SCOUNT, SCOUNT +1 and SCOUNT +2 registers, respectively. Verify R1, R2, and R3 are incrementing in a positive direction every 67 ± 2 seconds.

NOTE: If Standby Power (G&N IMU RTR with G&N computer breakers) has been off for two hours or more allow two hours warm up before proceeding. If the G&N System has been off for less than two hours, allow an equal time period for warm up before proceeding.

6.2.2.2.17 After required warm up time has elapsed, set the G&N IMU MN A and MN B breakers on the Right Hand Circuit Breaker panel to ON position (breakers pulsed in). Press the COARS ALIGN pushbutton on the IMU Control Panel. Ensure that the IMU +28 VDC OPERATE (ON) lamp on Event Module is lighted. (CG 1503). Verify that the value CG 1500, IMU +28 V on the CRT (+24.5 to +30.5 VDC). The gimbal lock lamp on the Conditioner Annunciator is lighted.

6.2.2.2.18 Ensure that the IMU DELAY lamp on the Condition Light Annunciator Panel is lighted and the IMU DELAY lamp on Event Module is lighted (CG 5008).

6.2.2.2.19 Set the G&N OPTICS MN A and MN B breakers on the Right Hand Circuit Breaker Panel to ON position (breaker pushed in). Ensure that the OPTX +28 VDC discrete lamp on Event Module is lighted. (CG 1533)

6.2.2.2.20 Verify the value CG 1530, OPTX +28V on the CRT (+25 to 30.8 VDC). Verify that the secondary power supply voltages of the following signals as displayed on the CRT is as indicated in Table VI.

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TABLE VI. SECONDARY POWER SUPPLY VOLTAGES

Meas. No.	Signal	Requirement
a. CG 1000	+120 VDC IRIQ Supply	+112.0 to +146 VDC
b. CG 1003	+12 VDC IRIQ Supply	+10.6 to +13.4 VDC
c. CG 1006	+32 VDC IRLQ Supply	+25.5 to +35.5 VDC
d. CG 1010	+120 VDC PIPA Supply	+107 to +145 VDC
e. CG 1016	+32 VDC PIPA Supply	+25.5 to +35.5 VDC
f. CG 1101	-28 VDC ELECTRONICS	-21.3 to -33.7 VDC
g. CG 1201	IMU 28 V 800 CPS 14-0°	+27 to +29 VRMS
h. CG 1202	IMU 28V 800 CPS 54-90°	+26.1 to +29.9 VRMS
i. CG 1203	IMU 28V 800 CPS 54-0°	+24.7 to +30.3 VRMS
j. CG 1204	CMU 28 800 CPS 54-90°	+26.1 to +29.9 VRMS
k. CG 1301	IMU 2V 3200 CPS SUPPLY	2.8 to 4.2 VRMS
l. CG 1302	20V 3200 CPS SQ WAVE	+15.6 to +24.4 VRMS
m. CG 1400	IMU 2.5V 25.6 MC in ϕ	+2.1 to +2.9 VRMS
n. CG 1110	+2.5 VDC T/M REFERENCE	+2.45 to +2.55 VDC
o. CG 1211	OPTX 28V 800 CPS 14-0°	+27 to +29 VRMS
p. CG 1212	OPTX 800 CPS 54-90°	+26.1 to +29.9 VRMS'
q. CG 1401	OPTX 2.5V 25.6 MC in ϕ	+2.1 to +2.9 VRMS

6.2.2.2.21 Set the TRANSFER switch on the IMU CONTROL panel to COMPUTER.

6.2.2.2.22 Enter and verify VERB 41, NOUN 20 into KL48. Press ENTER pushbutton to advance System to COARS ALIGN mode. The VERB-NOUN display on CRT shall flash and indicate 21-22.

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6.2.2.2.23 Enter and verify +00000 into K148 three times pressing the ENTER pushbutton on the K148 after each entry. The COARS ALIGN MODE lamp on the IMU CONTROL panel shall be the only MODE lamp that is lighted. The G&N ERROR lamp on the Condition Annunciator may be on.

6.2.2.2.24 Monitor the signals listed below on a CRT to ensure that the IMU is not in a Gimbal Lock condition. The signal shall indicate no gimbal oscillation movement.

	Meas. No.	Signal	Requirement
a.	CG 5003	GIMBAL LOCK WARNING	OFF
b.	CG 2142	MG CDU LX RES SINE	Not Oscillating
c.	CG 2143	MG CDU LX RES COSINE	Not Oscillating

6.2.2.2.25 Monitor the signals listed below on the CRT to verify normal PIPA loop operation.

a.	CG 2202	X PIPA SG OUT QUAD	Less than 0.66 VRMS
b.	CG 2022	Y PIPA SG OUT QUAD	Less than 0.66 VRMS
c.	CG 2042	Z PIPA SG OUT QUAD	Less than 0.66 VRMS

6.2.2.2.26 Perform 6.2.6 G&N Operational Test

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6.2.3 AGC Operational Test

NOTE: This test shall be performed only when IMU RTR and Computer powers are supplied. Test shall not be performed when IMU operate power is applied.

6.2.3.1 Verify IMU STANDBY power (including AGC operate power) is applied and IMU OPERATE power is not applied, and that AGC MODE switch is ON. (G&W IMU RTR MN A and MN B breakers engaged (breakers pushed in) computer MN A and MN B breakers engaged (breakers pushed in) IMU MN A and MN B breakers disengaged (breakers pulled out)).

6.2.3.1.1 Set the TRANSFER switch in MANUAL position on the IMU Control Panel.

6.2.3.1.2 Using LEB AGC DSKY, enter VERB 36. Press ENTER pushbutton. Press ERROR RESET on the LEB DSKY.

6.2.3.2 AGC Interface Checks

6.2.3.2.1 Enter the following sequence into the LEB AGC DSKY to initiate the DSKY test:

- a. VERB 57 ENTER
- b. 00007 ENTER

6.2.3.2.2 Observe all 9's displayed in the MAJOR MODE, VERB, HOUR and R1, R2 and R3 character positions and that the UPTL lamp is lighted. At approximately 10 second intervals, the following is displayed in the above character positions except where noted.

- a. 8's
- b. 7's
- c. 6's
- d. 5's
- e. 4's
- f. 3's
- g. 2's
- h. 1's
- i. 0's
- j. all positions blank
- k. MINUS signs in R1 R2 and R3
- l. PLUS signs in R1 R2 and R3 with the PROGRAM ALARM, TM FAIL, KEY RELEASE, CHECK FAIL and momentarily COMPUTER ACTIVITY lamps lighted.
- m. UPTL lamp not lighted

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6.2.3.2.2.1 Press ERROR RESET and KEY RELEASE pushbuttons. The KEY RELEASE and AGC alarm lamps shall not be lighted.

6.2.3.2.3 DSKY Pushbutton Check

6.2.3.2.3.1 Enter VERB 25, NOUN 02 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.2 Enter 01775 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.3 Enter +00123 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.4 Enter -00456 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.5 Enter -00789 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.6 Verify that +00123 is displayed in R1, -00456 is displayed in R2 and -00789 is displayed in R3 in the LEB and MDC AGC DSKY's.

6.2.3.2.3.7 Enter VERB 05, NOUN 02 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.8 Enter 01775 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.9 The LEB and MDC AGC DSKY's shall indicate 00178 in R1, 77067 in R2, and 76352 in R3. Verify the displays.

6.2.3.2.3.10 Repeat 6.2.3.2.3.1 through 6.2.3.2.3.9 using the MDC AGC DSKY.

6.2.3.2.4 C - Relay Check

NOTE: ACCEL FAIL, IMU FAIL, CDU FAIL and ZERO ENCODER lamps on Condition Annunciator panel will light intermittently during this test.

6.2.3.2.4.1 Enter the following sequence into MDC or LEB AGC DSKY to initiate the C-Relay Test:

a. VERB 15 NOUN 01	ENTER
b. 00722	ENTER
c. VERB 57	ENTER
d. 00006	ENTER

6.2.3.2.4.2 Press KEY RELEASE pushbutton after KEY RELEASE lamp lights. Rows R1, R2 and R3 shall display the contents of DSPTAB +11D, (R1), DSPTAB +12D, (R2), DSPTAB +13D, (R3).

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6.2.3.2.4.3 The DISTAB registers will count in the sequence 1, 2, 4, 10, 20, 40, 100, 200, 400, 1000, 2000, beginning with the register in R3, then R2 and finally R1. IN3 will then be displayed. Verify that the above sequence is followed throughout the test and that the final display of R3 is 00001 and IN3 register in R1 shall display one of the following: 0XXXX, 1XXXX, 2XXXX, and 3XXXX.

6.2.3.2.4.4 If an error exists, the PROGRAM ALARM lamp will be lighted and a VERB-NOUW display of 01-33 will flash and R1 on the CRT or DSKY will display 01103 or 41103 for multiple failures. Record.

6.2.3.3 AGC Alarms and Interrupt Test

NOTE: During the following test disregard AGC Alarm indications which are not noted on the test.
After each Error Reset for a test sequence insure all alarm lamps are not lighted.

6.2.3.3.1 Obtain G&N Alarms and Interrupts Test Tape No. F04C014-KU0020-00 and load the tape on TAPE READER.

6.2.3.3.2 Set the POWER/ON switch on the TAPE READER 4A4-A2 to ON. Perform the following steps on Console 4A4-A3 in sequence:

- a. Press the TAPE/KEY indicator to TAPE
- b. Press the FWD/REV indicator to FWD
- c. Press the IND/CONT indicator to CONT
- d. Press the LOAD/INH indicator to LOAD

6.2.3.3.3 Computer Activity

6.2.3.3.3.1 Press the RUN indicator switch on to RUN. Wait until tape stop.

6.2.3.3.3.2 Verify R1 indicates 00001 on CRT.

6.2.3.3.3.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.3.4 Verify that the COMPUTER ACTIVITY lamps on the MDC and LEB DSKY's and Event Module are lighted. The lamps shall remain lighted for approximately 10 seconds (CG 5021).

6.2.3.3.4 TC Trap (Due to constant TC instruction or an extended period without a TC instruction being generated)

6.2.3.3.4.1 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

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- 6.2.3.3.4.2 Verify R1 indicates 00002 on CRT.
- 6.2.3.3.4.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.
- 6.2.3.3.4.4 The TC TRAP alarm light shall be lighted. Verify indications on the LEB DSKY and Event Module (CG 5029). Press ERROR RESET pushbutton.
- 6.2.3.3.4.5 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.
- 6.2.3.3.4.6 Verify R1 indicates 00003 on CRT.
- 6.2.3.3.4.7 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.
- 6.2.3.3.4.8 The TC TRAP alarm light shall be lighted. Verify indication on LEB DSKY and Event Module (CG 5029). Press ERROR RESET.
- 6.2.3.3.5 RUPT LOCK (Due to extended or infrequent interrupts)
- 6.2.3.3.5.1 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.
- 6.2.3.3.5.2 Verify R1 indicates 00004 on CRT.
- 6.2.3.3.5.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.
- 6.2.3.3.5.4 The RUPT LOCK alarm light shall be lighted. Verify indication on LEB DSKY, Event Module, and CRT (CG). Disregard all other alarm indications. Press ERROR RESET.
- 6.2.3.3.5.5 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.
- 6.2.3.3.5.6 Verify R1 indicates 00005 on CRT.
- 6.2.3.3.5.7 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.
- 6.2.3.3.5.8 The RUPT LOCK alarm light shall be lighted. Verify indication on LEB DSKY, Event Module, and CRT (CG 5028). Disregard all other alarm indications. Press ERROR RESET.

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6.2.3.3.6 Parity Fail

6.2.3.3.6.1 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until the tape stops.

6.2.3.3.6.2 Verify that R1 indicates 00006 on CRT.

6.2.3.3.6.3 Press the RUN indicator on 4A4-K148 to RUN. Wait until the tape stops.

6.2.3.3.6.4 Verify that PARITY ALARM has been generated and displayed on the MDC and the LEB DSKY's and that the EVENT MODULE is lighted. Disregard all or any other alarm indications. Press ERROR RESET.

6.2.3.3.7 TELEMETRY FAIL ALARM

6.2.3.3.7.1 Press RUN indicator switch on 4A4-K148 to RUN. Wait until the tape stops.

6.2.3.3.7.2 Verify that R1 displays 00007 on the CRT.

6.2.3.3.7.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until the tape stops.

6.2.3.3.7.4 Verify that the TELEMETRY FAIL alarm is illuminated in the MDC and the LEB DSKY.

6.2.3.3.7.5 Verify that SEAL is indicated on the K-START module. Press ERROR RESET to clear AOC DSKY's.

6.2.3.3.7.6 Insert Verb 36 and ENTER into LEB DSKY. Insert VERB 21 NOUN 02 and ENTER into LEB DSKY. Insert 00041 and ENTER into LEB DSKY. Insert 00000 and ENTER into LEB DSKY.

6.2.3.3.8 Check Fail

6.2.3.3.8.1 Insert the following into the LEB DSKY to generate a CHECK FAIL:

- a. VERB 21 NOUN 01 ENTER
- b. 00003 ENTER
- c. Press ERROR RESET on LEB DSKY.

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6.2.4 Operate Power on and Power Supply Test

CAUTION

- a. Insure that the SYNC switch on MDC panel 25 is in the OFF position.
- b. The sequence specified in steps 6.2.4.1 through 6.2.4.6.10 must be adhered to. Deviation may necessitate recalibration of inertial components.

6.2.4.1 G&N breakers on the Right Hand Circuit Breaker Panel shall be in the following positions:

- a. COMPUTER MN A and MN B breakers ON (Breakers pushed in).
- b. IMU RTR MN A and MN B breakers ON (Breakers pushed in).
- c. IMU MN A and MN B breakers OFF (Breakers pulled out.)
- d. OPTICS MN A and MN B breakers OFF (Breakers pulled out).
- e. VIEWER AC1 and AC2 breakers ON (Breakers pushed in).
- f. G&N VIEWER toggle switch in AC1 (up).

6.2.4.2 The TRANSFER switch on the IMU CONTROL Panel shall be in MANUAL position.

6.2.4.3 The AGC MODE switch on AGC shall be set to ON position.

6.2.4.4 Switches and selectors on the G&N Indicator Control panel shall be set to the following positions:

- a. SLAVE TELESCOPE to STAR LOS
- b. OPTICS MODE to ZERO OPTICS
- c. CONTROLLER MODE to DIRECT
- d. CONTROLLER SPEED to LO
- e. POWER and BRIGHTNESS to OFF
- f. ALTITUDE IMPULSE ENABLE to OFF
- g. PANEL BRIGHTNESS to maximum increase
- h. IMU TEMP MODE to AUTO OVERRIDE

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6.2.4.5 IMU Operate Power

NOTE: Prior to switching to IMU Operate, the G&N System shall have been on Standby Mode with AGC power applied, for a minimum of two hours.

6.2.4.5.1 Set up the Analog Recorder 4A3-A2 and the switches on the Analog Select Panel 4A3-A3 to monitor the following signals:

- a. CG 2206 IGA CDU LX RES ERR
- b. CG 2236 MGA CDU LX RES ERR
- c. CG 2266 OGA CDU LX RES ERR

6.2.4.5.2 Start analog recorder using a chart speed of 5 MM/SEC. Start Event Recorder chart drive using chart speed of 10 MM/SEC. Prepare to mark the strip chart on analog recorder at the time IMU DELAY lamp extinguishes.

6.2.4.5.3 With the IMU in Standby Mode, the IMU Operate Power shall be applied by actuating the G&N IMU MN A and MN B breakers on the Right Hand Circuit Breaker Panel (breaker-pushed in). Press COARS ALIGN mode lamp on IMU Control Panel.

6.2.4.5.4 IMU DELAY lamps on the Condition Annunciator Panel, and Event Module shall be lighted when IMU Operate Power is applied (CG 1503). The IMU DELAY lamp shall extinguish after a time delay of 100 ± 10 seconds (CG 5008).

6.2.4.5.5 The COARS ALIGN (Coarse Align), MODE lamp on the IMU CONTROL Panel shall be lighted when IMU Operate power is switched on. After a time delay of 100 ± 10 seconds, the COARS ALIGN lamp shall remain lighted. The gimbal lock lamp on Condition Annunciator panel may be lighted.

6.2.4.5.6 After the IMU DELAY lamps go out, mark the strip chart, stop the Event Recorder, and record the time at which the IMU DELAY lamp is extinguished.

6.2.4.5.7 Stop the Analog Recorder 4A3-A2. Record the time at which the initial transient on OGA CDU LX Resolver Error signals occurred from Analog Recorder 4A3-A2.

6.2.4.5.8 Determine elapsed time between OGA LX resolver initial transient and IMU DELAY lamp going out from the recorders.

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- 6.2.4.5.9 Just prior to the time when the IMU DELAY lamp extinguishes, the Outer, Middle, and Inner IMU-CDU LX Resolver nulls shall be less than 0.600 VRMS (CG 2266, CG 2236, and CG 2206). Record the amplitude of all CDU LX resolver signals from Analog Recorder 4A3-A2.
- 6.2.4.5.10 IMU +28 VDC OPERATE discrete shall be issued (CG 1503) by observing that the IMU OPERATE lamp on Event Module is lighted. Record the value of CG 1500, IMU +28V on the CRT (+24.5 to 30.5 VDC).
- 6.2.4.6 Optics Power On
- 6.2.4.6.1 Optics power shall be applied by actuating the G&N OPTICD MN A and OPTICS MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).
- 6.2.4.6.2 OPTICS +28 VDC discrete shall be issued (CG 1533) by observing that the OPTICS lamp on Event Module is lighted. Record the value of CG 1530, OPTX +28V on the CRT (+24.5 to 30.5 VDC).
- 6.2.4.6.3 Verify that the ZERO ENCODER on the Condition Annunciator Panel is lighted for no more than 90 seconds after Optics Power Turn On.
- 6.2.4.6.4 The SHAFT ANGLE and TRUNNION ANGLE adjacent to the Scanning Telescope eyepiece shall be 0.0 ± 1.0 degree.
- 6.2.4.7 Set TRANSFER switch on the IMU CONTROL panel to COMPUTER. Disregard all computer alarms. Enter VERB 30, press ENTER pushbutton, then press ERROR RESET pushbutton. All alarms shall clear.
- 6.2.4.8 Enter and verify VERB 41, MOUN 20 into K148. Press ENTER pushbutton to advance system to COARSE ALIGN under AGC control. The VERB MOUN display on CRT shall flash and indicate 21-22.
- 6.2.4.9 Enter and verify +00000 into K148 three times, pressing the ENTER pushbutton after each entry. The COARSE ALIGN mode lamp on the IMU CONTROL panel shall be the only MODE lamp lighted. Insure that gimbal Lock lamp on Condition Annunciator panel is not lighted.
- 6.2.4.10 Secondary Power Supply Voltages, Noise Peaks and Phase Difference

NOTE: Ensure that the IMU Operate Power has been on for a minimum of 15 minutes before proceeding with this test.

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6.2.4.10.1 Record the secondary power supply voltages of the following signals displayed on the CRT.

<u>Item No.</u>	<u>Measurement No.</u>	<u>Signal</u>	<u>Requirement</u>
a.	CG 1000	+120 VDC IIRIG SUPPLY	+112 to +146 VDC
b.	CG 1003	+ 12 VDC IIRIG SUPPLY	+10.6 to +13.4 VDC
c.	CG 1006	+ 32 VDC IIRIG SUPPLY	+25.5 to +35.5 VDC
d.	CG 1010	+120 VDC PIPA SUPPLY	+107 to +145 VDC
e.	CG 1016	+ 32 VDC PIPA SUPPLY	+25.5 to +35.5 VDC
f.	CG 1020	+ 13 VDC AGC SUPPLY	+11.7 to +14.3 VDC
g.	CG 1030	+ 3 VDC AGC SUPPLY	+1.88 to +4.12 VDC
h.	CG 1101	- 28 VDC SUPPLY	-33.7 to -21.3 VDC
i.	CG 1110	+2.5 VDC TM BIAS	+2.45 to +2.55 VDC
j.	CG 1301	IMU 2V 3200 CPS SUPPLY RMS	2.8 to 4.2 VRMS
k.	CG 1400	IMU 2V 25.6 KC SUPPLY IN PH	+2.1 to +2.9 VRMS
l.	CG 1401	OPTX 2V 25.6 KC SUPPLY IN PH	+2.1 to +2.9 VRMS
m.	CG 1201	IMU 28V .8 KC 1 PCT 0 Deg SUP RMS	+27 to +29 VRMS
n.	CG 1202	IMU 28V .8KC 5 PCT 90 Deg SUP RMS	+26.1 to +29.9 VRMS
o.	CG 1203	IMU 28V .8 KC 5 PCT 0 Deg SUP RMS	+24.7 to +30.3 VRMS
p.	CG 1204	CDU 28V .8 KC PCT 90 Deg SUP RMS	+26.1 to +29.9 VRMS
q.	CG 1211	OPTX 28V .8 KC 1 PCT 0 Deg SUP RMS	+27 to 29 VRMS
r.	CG 1212	OPTX 28V .9 KC 5 PCT -90 Deg SUP RMS	+26.1 to +29.9 VRMS
s.	CG 1302	20V 3.2 KC SQ WAVE SUPPLY RMS	+15.6 to +24.4 VRMS

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6.2.4.10.2 Record the noise peaks of the following signals displayed on the CRT:

Item No.	Meas't No.	Signal	Requirement
a.	CG 1001	+120 VDC IRIG NOISE RMS	Less than +1.00VRMS
b.	CG 1011	+120 VDC PIPA NOISE RMS	Less than +1.0 VRMS
c.	CG 1021	+13 VDC AGC NOISE RMS	Less than 0.65 VRMS
d.	CG 1031	+3 VDC AGC NOISE RMS	Less than 0.65 VRMS
e.	CG 1501	+28 VDC No. 1 NOISE RMS	Less than +0.70 VRMS
f.	CG 1511	+28 VDC No. 2 NOISE RMS	Less than +0.70 VRMS
g.	CG 1521	+28 VDC No. 3 NOISE RMS	Less than +0.70 VRMS
h.	CG 1531	+28 VDC No. 4 NOISE RMS	Less than +0.70 VRMS

6.2.4.10.3 Record the phase difference of the following signals displayed on the CRT:

a.	CG 1206	PH DIF IMU 1 $\frac{1}{2}$ 0 $^{\circ}$, IMU 5 $\frac{1}{2}$ 90 $^{\circ}$	-77.0 to -103 $^{\circ}$
b.	CG 1207	PH DIF IMU 5 $\frac{1}{2}$ 0 $^{\circ}$, IMU 5 $\frac{1}{2}$ 90 $^{\circ}$	-77.0 to -103 $^{\circ}$
c.	CG 1306	PH DIF IMU 2V 3.2KC AGC SYNC	-12.5 to +12.5 $^{\circ}$
d.	CG 1209	PH DIF IMU 1 $\frac{1}{2}$ 0 $^{\circ}$ CDU 5 $\frac{1}{2}$ 90 $^{\circ}$	-77 to -103 $^{\circ}$
e.	CG 1220	PH DIF IMU 1 $\frac{1}{2}$ 0 $^{\circ}$ OPTX 1 $\frac{1}{2}$ 0 $^{\circ}$	-12.5 to +12.5 $^{\circ}$
f.	CG 1402	PH DIF IMU 25.6KC OPTX 25.6KC	-32 to +32 $^{\circ}$
g.	CG 1216	PH DIF OPTX 1 $\frac{1}{2}$ 0 $^{\circ}$ OPTX 5 $\frac{1}{2}$ 90 $^{\circ}$	-77 to -103 $^{\circ}$

6.2.4.10.4 The noise peaks of the following signals are demonstrated on the event lights when the peak voltage exceeds 5 volts and is present for more than one microsecond.

			Event Module
a.	CG 1022	+13 VDC AGC NOISE PEAK	4A3-A5
b.	CG 1032	+3 VDC AGC NOISE PEAK	4A3-A5
c.	CG 1502	+28 VDC No. 1 NOISE PEAK	4A3-A5
d.	CG 1512	+28 VDC No. 2 NOISE PEAK	4A3-A5
e.	CG 1522	+28 VDC No. 3 NOISE PEAK	4A3-A5
f.	CG 1532	+28 VDC No. 4 NOISE PEAK	4A3-A5

6.2.4.10.5 Perform 6.2.6 G&N Operational Test..

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6.2.5 Failure Indicating Circuitry Test

6.2.5.1 Proceed with this test of 6.2.4 Operate Power On Test has been completed. If system power is on, perform 6.2.2.1 before proceeding. If system power is off, proceed to 6.2.5.2.

NOTE: Ensure that the following cables which supply heater power to the IMU are not disconnected.

- a. Ensure that 1901529 cable is connected from 45A7J2 on PSA TRAY 7 to J11 on A23-201 PSA Adapter Module.
- b. C14-462 cable connected between J2 on A23-201 PSA Adapter Module and J6 on ICTO.

NOTE: Utilize a portable table or equivalent support to set the 190808-011 Heat Sink, 1900809-011 Failure Indicator Tester, 1900806-011 Breakout Box and PSA Tray 2 when removed.

6.2.5.2 Disconnect PSA Adapter connector from PSA trays (Connectors J1 through J10) except 1902438 cable connected to 45A7J2 on PSA Tray 7.

6.2.5.3 Disengage holding screws and carefully remove A23-201 away from the Power Servo Assembly unit. There is sufficient clearance to remove PSA Tray 2.

6.2.5.4 Disengage captivated screw on PSA Tray 2 from PSA toe cap.

6.2.5.5 Remove PSA Tray 2 from Servo Assembly and place on 1900808-011 Heat Sink.

6.2.5.6 **NOTE:** Avoid damage to thermal interface material in the following step.

6.2.5.6 Install 1900806-011 PSA Tray Extender in PSA Tray 2 position by carefully guiding the tongue into the slot located in PSA end and connector.

6.2.5.7 Engage captivated screw on PSA Tray Extender into PSA toe cap and tighten 15 ± 5 inch-pounds torque.

6.2.5.8 Connect cable from 1900806-011 Breakout Box to connector J2 on 1900809-011 Failure Indicator Tester.

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- 6.2.5.9 Mate connector J1 to connector 45A2P1 located on rear of PSA Tray 2.
- 6.2.5.10 Set and verify all switches to normal.
- 6.2.5.11 Re-install PSA Adapter Module in front of Power Servo Assembly.
- 6.2.5.12 Connect PSA Adapter connectors to PSA Tray 1 and 3 through 10. Torque each connector no greater than 95 ± 5 inch-ounces.
- 6.2.5.13 Connect cable from connector 45A2J1 on PSA Tray 2 to PSA Adapter Module (Tray 2 position) connector.
- 6.2.5.14 Set and verify transfer switch to MANUAL on the IMU control panel. Place G&N VIEWER AC1 and AC2 breaker on the Right Hand Circuit Breaker Panel to ON position.
- 6.2.5.15 Apply AGC power by placing the G&N Computer 'IN A and MN B breakers on the Right Hand Circuit Breaker Panel to ON position.
- 6.2.5.16 Close the IMU HTR MN A and MN B circuit breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).
- 6.2.5.17 Record the time in which the IMU HTR power was applied.
- 6.2.5.18 Insert the following into LEB DSKY:
Insert VERB 21, NOUN 02 and ENTER
Insert 00041 and ENTER
Insert 00000 and ENTER
- 6.2.5.19 Insert VERB 36 into K148 and press ENTER pushbutton. Press ERROR RESET pushbutton to clear computer alarms. All alarms shall clear.
- 6.2.5.20 Verify that all switches on the Failure Indicator Tester are in the OFF position.
- 6.2.5.21 Place G&N IMU MN A and MN B breakers on the Right Hand Circuit Breaker panel to ON position. Immediately press COARS ALIGN pushbutton on IMU CONTROL panel..Wait 100 + 10 seconds for IMU DELAY lamp on Condition Annunciator to extinguish. Verify that GIMBAL LOCK lamp is lighted.
- 6.2.5.22 Verify that +28 VDC Operate CG 1503 lamp is lighted on Event Module.
- 6.2.5.23 Place the G&N OPTICS MN A and MN B breakers on the Right Hand Circuit Breaker Panel to ON position.

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- 6.2.5.24 Verify that +28 VDC OPTX CG 1533 lamp is lighted on Event Module.
- 6.2.5.25 Observe CRT and verify that IRIG and PIPA temperature indication and G&M system power supply indications are not flashing.
- 6.2.5.26 Place the CAUT and WARN COMP UNIT MN A and MN B breakers on the Left Hand Circuit Breaker Panel No. 25 to ON position.
- 6.2.5.27 On the MDC Panel No. 11, Place the CAUTION/WARNING switch to C/M position and PWR switch to 1 position.
- 6.2.5.28 Press ERROR RESET pushbutton to clear computer alarms. All alarms shall clear.
- 6.2.5.29 Set and verify the TRANSFER switch to COMPUTER on the IMU CONTROL panel.
- 6.2.5.30 Insert and verify VERB 41, NOUN 20 into K148. Press ENTER pushbutton.
- 6.2.5.31 Insert and verify +00000 into K148 three times, pressing ENTER pushbutton after each insertion. Wait 60 seconds before proceeding.
- 6.2.5.32 IMU Fail (CG 5001)
- 6.2.5.32.1 Momentarily set each of the following switches one at a time on the Failure Indicator Tester of PSA Tray Extender Set to TEST. Observe the fail indications as displayed on 6.2.5.32.2. Return each switch to OFF and press MASTER CAUTION lamp button on MDC Panel 3 before proceeding with the next switch.
- a. MICROSYN EXCITATION
 - b. WHEEL EXCITATION
 - c. IG SERVO ERROR
 - d. MG SERVO ERROR
 - e. OG SERVO ERROR

6.2.5.32.2	Condition	Main	A C E	
	Annunciator Panel	Display Panel	Event Module	Event Record
	IMU FAIL	IMU FAIL	IMU FAIL	IMU FAIL
	POMS	*G&M ERROR	*FAILURE DETECT	ERROR DETECT
	MASTER ALARM	MASTER ALARM	ERROR DETECT	

* Function only in Night watchman Program routine.
Otherwise the lamp remains lighted.

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6.2.5.33 CDU Fail (CG 5002)

6.2.5.33.1 Momentarily set each of the following switches one at a time on the Failure Indicator Tester of PSA Tray Extender Set to TEST. Observe the fail indications as displayed on 6.2.5.33.2. Return each switch to OFF and press MASTER CAUTION lamp button on MDC Panel 18 before proceeding with the next switch.

- ENCODER EXCITATION
- CDU EXCITATION
- IC CDU ERROR
- MG CDU ERROR
- OG CDU ERROR

6.2.5.33.2 Condition Annunciator Panel	Main Display Console	Event Module	A C E CRT	Event Recorder
CDU FAIL	CDU FAIL	CDU FAIL	CDU FAIL ON	CDU FAIL
PONS	*O&N ERROR	*FAILURE DETECT		ERROR DETECT
MASTER ALARM	MASTER ALARM	ERROR DETECT		

* Function only in Night watchman Program routine. Otherwise the lamp remains lighted.

6.2.5.34 PIPA FAIL (CG 5000)

6.2.5.34.1 Momentarily set each of the following switches one at a time on the Failure Indicator Tester of PSA Tray Extender Set to TEST. Observe the fail indications as displayed in 6.2.5.34.2. Return each switch to OFF and press MASTER CAUTION lamp button on MDC Panel 3 before proceeding with the next switch.

- X PIP ERROR
- Y PIP ERROR
- Z PIP ERROR

6.2.5.34.2 Condition Annunciator Panel	Main Display Console	Event Module	A C E CRT	Event Recorder
ACCEL FAIL	ACCEL FAIL	PIPA FAIL	PIPA FAIL ON	PIPA FAIL
PONS	*O&N ERROR	*FAILURE DETECT		ERROR DETECT
MASTER ALARM	MASTER ALARM	ERROR DETECT		

* Function only in Night watchman Program routine. Otherwise the lamp remains lighted.

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6.2.5.35 Gimbal Lock Test

- 6.2.5.35.1 Insert and verify VERB 41, NOUN 20 into K148. Press ENTER pushbutton.
- 6.2.5.35.2 Insert and verify +00000 into K148 two times, processing ENTER pushbutton after each insertion.
- 6.2.5.35.3 Insert and verify +05400 into K148. Press ENTER pushbutton. Wait 60 seconds.
- 6.2.5.35.4 Verify that GIMBAL LOCK lamp on Condition Annunciator panel is not lighted.
- 6.2.5.35.5 Insert and verify VERB 23, NOUN 22 into K148. Press ENTER pushbutton.
- 6.2.5.35.6 Insert and verify +06500 into K148. Press ENTER pushbutton. Wait 60 seconds.
- 6.2.5.35.7 Verify that GIMBAL LOCK lamp on Condition Annunciator panel is lighted.
- 6.2.5.35.8 Insert and verify VERB 23, NOUN 22 into K148. Press ENTER pushbutton.
- 6.2.5.35.9 Insert and verify +18000 into K148. Press ENTER pushbutton and observe that GIMBAL LOCK lamp remains lighted while IMU and CDU are driving to 180 degrees. Wait 60 seconds.
- 6.2.5.35.10 Insert and verify VERB 23, NOUN 22 into K148. Press ENTER pushbutton.
- 6.2.5.35.11 Insert and verify +29500 into K148. Press ENTER pushbutton and observe that GIMBAL LOCK lamp remains lighted while IMU and CDU are driving to 295 degrees. Wait 60 seconds.
- 6.2.5.35.12 Insert and verify VERB 23, NOUN 22 into K148. Press ENTER pushbutton.
- 6.2.5.35.13 Insert and verify +30600 into K148. Press ENTER pushbutton. Wait 60 seconds.
- 6.2.5.35.14 Verify that the GIMBAL LOCK lamp on Condition Annunciator panel is not lighted.
- 6.2.5.36 Removal of PSA Tray Extender Set
- 6.2.5.36.1 Perform 6.2.2.1 to Turn Off G&N System.

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NOTE: Ensure that the following cables, which supply heater power to the IMU are not disconnected.

- a. 1901529 W102 cable connected between 45A7J2 on PSA Tray 7 and J1 on A23-201 PSA Adapter Module.
- b. C14-462 cable connected between J2 on A23-201 PSA Adapter Module and J6 on ICTC.

- 6.2.5.36.2 On the PSA Adapter Module (A23-201) disconnect cable from connector 45A2J1 on PSA Tray 2 to PSA Adapter Module (Tray 2 position) connector.
- 6.2.5.36.3 Disconnect the ten connectors to ACE-SC Carry-on conditioning equipment.
- 6.2.5.36.4 Disconnect PSA Adapter connectors from PSA Trays (connectors 45A1J1 through 45A10J1) except 1902438 cable connected to 45A7J2 on PSA Tray 7.
- 6.2.5.36.5 Disengage the holding screws and carefully remove A23-201 away from the Power Servo Assembly until there is sufficient clearance to remove PSA Tray 2.
- 6.2.5.36.6 On the Failure Indicator Tester (1900809-011), disconnect connector J1 from connector 45A2F1 located on rear of PSA Tray 2.
- 6.2.5.36.7 Disengage captivated screws on 1900805-011 PSA Tray Extender (located in PSA Tray 2 position) from PSA Toe Cap and remove from Power Servo Assembly.
- 6.2.5.36.8 Re-install PSA Tray 2 by carefully guiding the tongue into the slot located in PSA and connector and plug into connector 56J12. Tighten the captive screw to 27.5 ± 2.5 inch-pounds torque.
- 6.2.5.36.9 Re-install PSA Adapter Module (A23-201) in front of PSA).
- 6.2.5.36.10 Connect PSA Adapter connectors to all PSA Tray connectors 45A1J1 through 45A10J1. Torque each connector no greater than 100 inch-pounds.
- 6.2.5.36.11 Re-connect the ten connectors from ACE-SC carry-on conditioning equipment.
- 6.2.5.36.12 Perform Turn On Procedures as specified in 6.2.2.2.

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6.2.6 G&N Operational Test

Proceed with this test if 6.2.5 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been ~~interrupted~~, perform 6.2.2.2 Turn On Procedure.

6.2.6.1 Initial Conditions

6.2.6.1.1 Ensure that the AOC MODE switch is in the ON position.

6.2.6.1.2 Verify that TRANSFER switch on IMU CONTROL Panel is in COMPUTER position and that the AOC Mode switch is in the ON position.

6.2.6.2 Initiation

6.2.6.2.1 Insert the following sequence into K148.

- a) VERB 57 ENTER
- b) 00004 ENTER

6.2.6.2.2 Verify that the PROGRAM display on CRT indicates 07.

NOTE: During this portion of the test, the G&N System is exercised through its modes and the MODE lamp displays will change automatically in the following sequence: ZERO ENCODE, FINE ALIGN, ATTITUDE CONTROL, COARSE ALIGN and FINE ALIGN. If the PROGRAM display on the LEB DSKY does not change, proper mode changing is occurring.

6.2.6.2.3 After approximately 10 minutes, the value of the gravity vector in CM/SEC² shall be displayed in R1 and R2 on CRT. Record these values. Verify VERB 06, NOUN 66 are flashing near end of 10 minute period.

6.2.6.2.4 R1 is the first five digits of the gravity vector and R2 contains the last five digits. A decimal point shall be between them. The value for the gravity vector shall be $+980.00000 + 10.00000 \text{ CM/SEC}^2$.

6.2.6.2.5 Enter VERB 33 into K148. Press the ENTER pushbutton. Verify that VERB 06 and NOUN 66 are flashing.

6.2.6.2.6 The value of the horizontal earth rate shall be displayed in R1 and R2 on CRT. Record these values.

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6.2.6.2.7 R1 is the first five digits of earth rate and R2 contains the last five digits. A decimal point shall be placed between R1 and R2. The horizontal earth rate shall be 00000.82980 \pm .20000 ERU (Earth Rate Unit).

6.2.6.3 Test Termination

6.2.6.3.1 Enter VERB 34 into K148. Press the ENTER pushbutton.

6.2.6.3.2 Enter VERB 41, NOUN 20 into K148. Press the ENTER pushbutton.

6.2.6.3.3 Enter 00000 into K148. Press the ENTER pushbutton.

6.2.6.3.4 Enter 00000 into K148. Press the ENTER pushbutton.

6.2.6.3.5 Enter 00000 into K148. Press the ENTER pushbutton.

6.2.6.3.6 Verify COARSE ALIGN is the only Mode lamp lighted.

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6.2.7 IMU Temperature Control Test

6.2.7.1 Proceed with this test if test in 6.2.4, Operate Power On Test, has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2 before proceeding. The signal values of this test are to be recorded as displayed on the CRT. The following Measurement Numbers and Signals are inserted here as a convenience for later reference.

ITEM NO.	MEASUREMENT NO.	SIGNAL
a.	CG 2300	PIPA TEMP
b.	CG 2301	IRIG TEMP
c.	CG 2302	HEATER CURRENT
d.	CG 2303	BLOWER CURRENT
e.	CG 2304	T.C. BRIDGE SUPPLY

6.2.7.1.1 Insure that the following Ground Support Equipment (GSE), identified in 4.1, is installed and connected before proceeding with 6.2.7.2

- a. Digital Signal Conditioning and Multiplexing Unit, Model No. C14-211.
- b. G&W Signal Conditioning and Switching Matrix Unit (DTMS) Item 7.
- c. Carry-On Command Stimuli Unit (ACE-S/C Digital Test Command System DTCS) Item 1.
- d. ACE-SC Carry-On Junction Box Item 3.
- e. PSA Adapter Module Item 17.
- f. External Digital Test Command Unit Item 9.
- g. Data Interleaver System Item 10.
- h. Electrical Cable Set Item 13.

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- 6.2.7.2 Set the TRANSFER switch on the IMU CONTROL panel to MANUAL. Reset any AGC alarms by entering VERB 36, pressing ENTER pushbutton then pressing ERROR RESET pushbutton on LEB AGC DSXY.
- 6.2.7.3 Place the G&N IMU to Standby Mode by positioning the G&N IMU MW A and MW B breakers on the Right Hand Circuit Breaker Panel to OFF (Breakers pulled out). Note that the IMU OPERATE discrete lamp on Event Module is not lighted.
- 6.2.7.4 Place the IMU TEMP MODE selector on the G&N Indicator Control Panel to AUTO OVERRIDE position.
- 6.2.7.5 With the IMU in the Standby Mode, wait 30 minutes and record the values of the following signals as displayed on CRT. The BLOWER CURRENT will not be on at this time (CG 2303).

Measurement No.	Signal	Requirements
a. CG 2300	PIPA TEMP	128.0°F to 135.0°F
b. CG 2301	IRIG TEMP	128.0°F to 135.0°F
c. CG 2302	HEATER CURRENT	0.75 to 1.60 AMP
d. CG 2304	T.C. BRIDGE SUPPLY	18.7 to 25.3 VDC

- 6.2.7.6 Place the G&N IMU to Operate Mode by setting the G&N IMU MW A and MW B breakers on the Right Hand Circuit Breaker Panel to ON position. After the IMU DELAY lamp goes out, press the COARS ALIGN pushbutton on the IMU CONTROL panel. The COARS ALIGN lamp is the only MODE lamp that is lighted. Record the time when IMU Operate power is applied.
- 6.2.7.7 Place the TRANSFER switch on the IMU control panel to COMPUTER.
- 6.2.7.8 Enter VERB 40, MOUNT 20 into K148. Press ENTER pushbutton. Wait: 90 seconds.
- 6.2.7.9 Enter VERB 41, MOUNT 20 into K148. Press ENTER pushbutton.
- 6.2.7.10 Enter +00000 into K148 three times, pressing ENTER pushbutton after each entry. COARS ALIGN mode lamp on the IMU CONTROL panel shall be the only MODE lamp lighted.
- 6.2.7.11 Proportional Mode
- 6.2.7.11.1 Set the IMU TEMP MODE selector on the G&N Indicator Control Panel to PROPORTIONAL position.

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6.2.7.11.2 Thirty minutes after IMU Operate Mode, the signal values of 6.2.7.1 shall be as follows:

- a. The PIPA temperature shall be 129.0° to 131.0°F and the IRIG temperature shall be 132.0 to 135.0°F (CG 2300, CG 2301).
- b. The Heater current shall be 0.55 to 1.41 amperes (when current is applied) (CG 2302).
- c. The Blower current shall be 0.15 to 0.55 amperes (when current is applied) (CG 2303).
- d. The Temperature Control Bridge supply shall be 18.7 to 25.3 VDC (CG 2303).

6.2.7.11.3 After two hours from time IMU MW A and MW B power was applied, the following values shall be present.

- a. The PIPA Temperature shall be 129.5 to 130.5°F and the IRIG temperature shall be 132.5 to 136.5°F (CG 2300, CG 2301).
- b. The Heater current shall be 0.55 to 1.41 amperes (when current is applied) (CG 2302).
- c. The Blower current shall be 0.15 to 0.55 amperes (when current is applied) (CG 2303).

6.2.7.11.4 Set IMU TEMP MODE selector to AUTO OVERRIDE. Monitor at 5-minute intervals the values of signals a and b in 6.2.7.1 for 15 minutes (3 monitor periods). Record the maximum values of each signal during this time. These values shall be within those requirements listed in 6.2.7.11.4.

6.2.7.12 Backup Mode

6.2.7.12.1 Set the IMU TEMP MODE selector on the G&W Indicator Control Panel to BACKUP position. The IMU TEMP lamp on Condition Annunciator Panel will cycle on and off.

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after 60 minutes:

- a. The PIPA temperature shall be 129.5 to 133.0°F.
- b. The IRIQ temperature shall be 134.5 to 137.5°F.

6.2.7.12.2 Monitor at 5 minute intervals, the values of signals a and b in 6.2.7.1. At the end of 15 minutes (3 monitor periods) record the maximum and minimum values of these signals. The values shall be within those requirements listed in 6.2.7.12.1.

6.2.7.13 Emergency Mode

6.2.7.13.1 Set the IMU TEMP MODE selector on the G&N Indicator Control Panel to EMERGENCY position. The IMU TEMP lamp on the condition annunciator panel will be on during EMERGENCY MODE.

6.2.7.13.2 After the IMU has been switched to EMERGENCY control for a minimum of one hour, the IRIQ temperature shall remain within + 2.0°F of its value in 6.2.7.11.3 and PIPA temperature shall remain within ± 2.0 F of its value in 6.2.7.11.4 as indicated on the CRT.

6.2.7.14 Auto Override Mode

6.2.7.14.1 Set the IMU TEMP MODE selector on the G&N Indicator Control Panel to AUTO OVERRIDE position. Wait 30 minutes. The signal values shall be as follows: Record the values.

- a. The PIPA Temperature shall be within 129.0 to 131.0°F and the IRIQ temperature shall be within 132.0 to 135.0°F (CG 2300, CG 2301).
- b. The IMU temperature shall be within 132.0 to 135.0°F (CG 2300, CG 2301).

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6.2.8 AOC Clock Frequency Test

- 6.2.8.1 Perform this test if 6.2.4, Operate Power On Test or 6.2.2.2, Power On Procedure has been completed and G&N System Operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2, Blower On Procedure before proceeding.
- 6.2.8.2 Ensure that the AOC has been operating for at least one hour before this test.
- 6.2.8.3 Ensure that the 5245L ELECTRONICS power has been applied for the length of time as required by the manufacturers' specifications.
- 6.2.8.4 Verify that the coax PIPA FREQ MON is connected between Signal Test Point and the AC Signal Input of 5245L ELECTRONIC COUNTER.
- 6.2.8.5 Set the switches on the 52452 ELECTRONIC COUNTER to the following positions:
 - 6.2.8.5.1 Set the Preset Counter to indicate 96000.
 - 6.2.8.5.2 Set TIME BASE to ms
 - 6.2.8.5.3 Set FUNCTION to TIME INTERVAL
 - 6.2.8.5.4 Set MODE to RX PERIOD
 - 6.2.8.5.5 Set SENSITIVITY to 1
- 6.2.8.6 Rotate the ACCEL MON selector switch on the PSA Adapter Module to ACE position.
- 6.2.8.7 Enter the code 1000 into R-START 4A4-A5-R147. The upper portion of the indicator shall be illuminated. Press the XEQ/SEAL pushbutton to switch the IMU 3.2 Kc power supply on to the hardline. Voltage shall be available on the vertical input to the PIPA Scope 4A4-A1.
- 6.2.8.8 Each count cycle should last approximately 30 seconds. Adjust display time to permit recording the display on the E-PUT.
- 6.2.8.9 Repeat the counting cycle 10 times and record the results of the 10 counting cycles. Calculate the average time per cycle for the 10 counting cycles. Record the average time per cycle.
- 6.2.8.10 The average time shall be not greater than

$$\frac{96000}{3199.9922} = 30.0000731 \text{ seconds, nor less than}$$

$$\frac{96000}{3200.0078} = 29.9999269 \text{ seconds}$$

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6.2.9 G&N Panel Brightness and Lamp Test

6.2.9.1 Panel Brightness Control Operation - the PANEL BRIGHTNESS thumb-wheel shall be exercised to demonstrate the capability of controlling the illumination of the following lamps:

- a. Optical Reticles
- b. Telescope Angle Readouts
- c. IMU-CDU Difference Display
- d. COARS ALIGN MODE lamp on IMU CONTROL Panel
- e. CDU Displays

6.2.9.2 Mode Indication Lamp Check - The CHECK MODE lamps pushbutton shall be depressed and cause the following MODE lamps to be illuminated:

- a. ZERO ENC
- b. COARS ALIGN
- c. FINE ALIGN
- d. CDU MAN
- e. ATT CONF
- f. ENTRY
- g. TRACKER

6.2.9.2.1 Release the CHECK MODE lamps pushbutton. All MODE lamps except COARS ALIGN lamp on the IMU CONTROL Panel shall be extinguished.

6.2.9.3 Condition indication Lamp Check. - Set CONDITION LAMP switch ON/OFF to ON position. The CHECK CONDITION lamps pushbutton shall be depressed and shall cause the following lamps to be illuminated:

- a. G&N Error
- b. COMP PWR FAIL
- c. IMU FAIL
- e. ACCEL FAIL

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- f. G&N FAIL
- g. GIMBAL LOCK
- h. IMU TEMP
- i. ZERO ENCODE
- j. IMU DELAY (This lamp will not illuminate in Systems Standby mode)
- k. MASTER WARNING
- l. MASTER CAUTION

6.2.9.3.1 Release CHECK CONDITION lamps pushbutton. All condition lamps on the Condition Annunciator Panel shall be extinguished.

6.2.9.4 AGC Display Indication - On depression of Test Alarm Switch, the proper operation of the AGC alarm circuitry will be demonstrated by the illumination of the following lamps:

- a. RUPT LOCK
- b. TC TRAP
- c. COUNTER FAIL
- d. PARITY FAIL
- e. G&N ERROR

6.2.9.4.1 Press ERROR RESET pushbutton. All alarm lamps on the AGC DSKY shall be extinguished.

6.2.9.5 Check Coolant - The CHECK COOLANT pushbutton shall be depressed and shall cause illumination of the area in which the coolant quick disconnects are contained. Verify that the quick disconnects are not leaking and the metallic areas of the quick disconnects, visible through the Port Holes, have no droplets of condensation that might drip.

6.2.9.5.1 Release CHECK COOLANT lamp pushbutton. The COOLANT lamp shall not be lighted.

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6.2.10 Optics Servo Tests

6.2.10.1 Proceed with this test if 6.2.4, Operate Power-On Test, has been completed, and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2, Turn-On Procedure, before proceeding.

6.2.10.2 Insure that the TRANSFER switch on the IMU Control Panel is set to COMPUTER.

6.2.10.3 Insure that the SLAVE TELESCOPE switch on the G&N Indicator Control Panel is set to STAR LOS, the TRACKER POWER switch is set to OFF and the TRACK pushbutton is not illuminated. Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO RECORDER lamp has extinguished, return the selector to MANUAL.

NOTE: If the G&N System is in IMU Operate Mode, ensure that the system is in Coarse Align Mode under AGC control.

6.2.10.4 Trunnion CDU Servo Loop Check

6.2.10.4.1 Set the CONTROLLER SPEED switch on the G&N Indicator Control Panel to MED and the CONTROLLER MODE switch to DIRECT.

6.2.10.4.2 Enter the code 2019000000 into the C-START module. Press the XEQ/SEAL pushbutton to call CG 3206 TRUNNION CDU TACH OUTPUT to the high rate channel of the Analog Recorder 4A1-A03.

6.2.10.4.3 Set up to monitor the following signals on the Analog Recorder 4A3-A02:

CG 3104 SXT TRUN MDA INPUT IMPHASE

6.2.10.4.4 Start the Analog Recorders at 5 mm/sec. Move and hold the OPTICS CONTROL STICK to its upper limit not longer than 10 sec. Release the control stick and stop the Analog Recorders. Record the maximum values of CG 3206, TRUNNION CDU TACH OUTPUT and CG 3104, SXT TRUN MDA INPUT IMPHASE.

6.2.10.4.5 The maximum value of CG 3206, TRUNNION CDU TACH OUTPUT, shall be 1.05 ± 0.20 VRMS. The maximum value of CG 3104, SXT TRUN MDA INPUT IMPHASE, shall be 1.25 ± 20 VRMS.

6.2.10.4.6 Set the CONTROLLER SPEED selector to LO.

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- 6.2.10.4.7 Set the OPTICS MODE selector to ZERO OPTICS. After ZERO ENCODER has extinguished, return the selector to MANUAL.
- 6.2.10.4.8 Repeat 6.2.10.4.4. The maximum value of CG 3206, TRUNNION CDU TACH OUTPUT, shall be 0.105 ± 0.020 VRMS. The maximum value of CG 3104, SXT SHAFT MDA INPUT INPHASE, shall be 0.125 ± 0.021 VRMS.
- 6.2.10.5 Shaft CDU Servo Loop Check
- 6.2.10.5.1 Enter the code 2020000000 into the C-START module. Press the XEQ/SEAL pushbutton to call CG 3226, SHAFT CDU TACH OUTPUT, to the high rate channel of Analog Recorder 4A1-A03.
- 6.2.10.5.2 Set the CONTROLLER SPEED selector on the G&N Indicator Control Panel to MED.
- 6.2.10.5.3 Place the OPTICS MODE selector on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO ENCODER has extinguished, place the selector to MANUAL.
- 6.2.10.5.4 Start the Analog Recorders 4A1-A03 and 4A3-A02 at 5 in/sec. Move and hold the OPTICS CONTROL STICK against its right limit for not longer than 10 sec. Release the control stick and stop the Analog Recorders. Record the maximum values of CG 3226, SHAFT CDU TACH OUTPUT and CG 3114, SXT SHAFT MDA INPUT INPHASE.
- 6.2.10.5.5 The maximum value of CG 3226, SHAFT CDU TACH OUTPUT, shall be 1.05 ± 0.20 VRMS. The maximum value of CG 3114, SXT SHAFT MDA INPUT INPHASE, shall be 1.25 ± 0.20 VRMS.
- 6.2.10.5.6 Set the CONTROLLER SPEED selector to LO.
- 6.2.10.5.7 Repeat 6.2.10.5.3 and 6.2.10.5.4. The maximum value of CG 3226, SHAFT CDU TACHOUTPUT shall be 0.105 ± 0.020 VRMS. The maximum value of CG 3114, SXT SHAFT MDA INPUT INPHASE shall be 0.125 ± 0.021 VRMS.
- 6.2.10.6 Optics Time to Zero
- 6.2.10.6.1 Set selector on G&N Indicator Control Panel to ZERO OPTICS. Wait 90 sec. Set selector on G&N Indicator Control Panel to MANUAL.

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- 6.2.10.6.2 Set up the Analog Recorder to monitor the following signals at a chart speed of 10 mm/sec. Do not start recorder at this time.
- | | |
|--|------------------------|
| | <u>Analog Recorder</u> |
| a. CG 3226, SHAFT CDU TACH OUTPUT | 4A3-A2-1-2 |
| b. CG 3206, TRUNNION CDU TACH OUTPUT | 4A3-A2-2-2 |
| c. CG 3124, SCT SHAFT TACH FEEDBACK | 4A3-A2-5-2 |
| d. CG 3134, SCT TRUNNION TACH FEEDBACK | 4A3-A2-6-2 |
- 6.2.10.6.3 Using the control stick, drive the 2X Trunnion CDU in a positive direction to 120.0XX degrees and the Shaft CDU to 270.0XX degrees.
- 6.2.10.6.4 Start the Analog Recorder and set the OPTICS MODE selector on the G&M Indicator Control Panel to ZERO OPTICS.
- 6.2.10.6.5 When all signals have reached a steady state value, set the attenuation on the Analog Recorder to the lowest usable ranges.
- 6.2.10.6.6 After 5 seconds, stop the recorder. Record the elapsed time between steady state nulls on all signals listed in 6.2.10.6.2. The elapsed time between steady state nulls shall be less than 27 sec. for signals a) and c) and less than 12 sec. for signals b) and d).
- 6.2.10.6.7 Record the level of the CG 3141 TRUNNION CDU 16X RESOLVER and CG 3211, SHAFT CDU 16X RESOLVER signals on the CRT. The absolute value of these signals shall be 0.005 VRMS.
- 6.2.10.6.8 Record the SHAFT and 2X TRUNNION CDU indications. The 2X TRUNNION and SHAFT angle readouts shall be 0.000 ± 0.006 degrees.
- 6.2.10.7 AGC Mode Indication and Control
- 6.2.10.7.1 Enter and verify VERB 16 and NOUN 55 into K148. Press the ENTER pushbutton. The AGC display R1 and R2 on the CRT shall be all zeros.
- 6.2.10.7.2 Enter and verify VERB 11 (MONITOR) and NOUN 01 (ADDRESS) into K148. Press the ENTER pushbutton.
- 6.2.10.7.3 Enter address 00007 into K148. Press the ENTER pushbutton. The AGC display on the CRT shall indicate the contents of IN3 in R1 to be X4XXX.
- 6.2.10.7.4 Set the OPTICS MODE selector on the G&M Indicator Control Panel to MANUAL. The AGC display on the CRT shall indicate contents of IN3 in R1 to be M0XXX.

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- 6.2.10.7.5 Set the OPTICS MODE selector on the G&N Indicator Control Panel to COMPUTER. The AGC display of Mode Register IN3 in R1 shall indicate 3XXXX or 7XXXX on CRT.
- 6.2.10.7.6 Enter the following sequence into the K148 and verify:
- a. VERB 21, NOUN 01, ENTER
 - d. VERB 41, NOUN 55, ENTER
 - b. 00723, ENTER
 - e. +03000, ENTER
 - c. 40000, ENTER
 - f. +15000, ENTER
- 6.2.10.7.7 Verify that the SHAFT and the 2X TRUNNION CDU move to 30.0 degrees.
- 6.2.10.7.8 Enter the following sequence into the K148:
- a. VERB 21, NOUN 01, ENTER
 - b. 00744 ENTER
- 6.2.10.7.9 Verify that the SHAFT and 2X TRUNNION CDU readouts move to 0.000 ± 0.006 degrees and stop.
- 6.2.10.7.10 Enter and verify VERB 16, NOUN 55 into K148. Press ENTER push-button. The AGC display of Registers R1 and R2 on the CRT shall be all zeros.
- 6.2.10.7.11 Set the OPTICS MODE selector on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, return selector to MANUAL.
- 6.2.11 Optics Slew Rate Test
- 6.2.11.1 Proceed with this test if 6.2.4, Operate Power-On Test, has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2, Turn-On Procedure, before proceeding.
- 6.2.11.2 Insure that the TRANSFER switch on the IMU Control Panel is set to COMPUTER, and that the OPTICS MODE switch is set to DIRECT position.
- 6.2.11.3 Verify that the G&N System is in the Coarse Align Mode under AGC control. COARSE ALIGN MODE lamp is the only MODE lamp that is lighted.
- 6.2.11.4 Slew Rate - High Speed
- 6.2.11.4.1 Set the CONTROLLER SPEED switch on the G&N Indicator Control Panel to HI.

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6.2.11.4.2 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lamp extinguishes, return OPTICS MODE selector to MANUAL position.

6.2.11.4.3 Record the SHAFT CDU and 2X TRUNNION CDU indications. The optics CDU readout shall be 00.000 ± 0.006 degrees.

NOTE: Read and understand section 6.2.11.4.4 before proceeding. Do not hold control stick at upper limit for more than ten seconds. Clear any indications on DSKY with "ERROR RESET" or "KEY RELEASE".

6.2.11.4.4 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Push the control stick to its upper limit. Two seconds later press the "MARK" pushbutton. Approximately five seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick. Verify KEY RLSE is lighted and press KEY RISE on LEB DSKY panel. Immediately record the displays in R1, R2, and R3. In a few seconds (approximately 10 seconds), the displays in R1, R2, and R3 change; record the second displays in R1, R2 and R3.

NOTE: The R1, R2, and R3 displays when the "KEY RLSE" pushbutton is pressed are as follows:
R1 is Shaft Angle as 000.00 ± 000.10 degrees
R2 is Trunnion LOS Angle as $xx.xxx$ degrees
R3 is time as $xxx.xx$ seconds

NOTE: If R1 is not within $\pm .10$ repeat 6.2.11.4.4.

6.2.11.4.5 Compute the respective differences between the R2 and R3 displays recorded in 6.2.11.4.4 as Δ Trun, and Δ Time.

6.2.11.4.6 Compute and record the Trunnion slew rate as the ratio degrees/second.

$$\frac{\Delta \text{ Trun}}{\Delta \text{ Time}}$$

6.2.11.4.7 The Trunnion slew rate shall be 9.0 ± 1.8 degrees/second.

6.2.11.4.8 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lamp is extinguished, return selector to MANUAL position.

6.2.11.4.9 Record the SHAFT CDU and 2X TRUNNION CDU indications. The Optics CDU readout shall be 000.000 ± 0.006 degrees.

NOTE: Read and understand section 6.2.11.4.10 before proceeding. Do not hold right control stick at right limit for more than ten seconds.

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6.2.11.4.10 Insert VERB 06, MOUN 56 and press ENTER on DSKY. Push the control stick to its right limit. Two seconds later press the "MARK" pushbutton. Approximately five seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick. Verify KEY RELEASE is displayed, press KEY RELEASE. IMMEDIATELY record the displays in R1, R2, and R3. In a few seconds (approximately 10 seconds), the displays in R1, R2 and R3 change; record the second displays in R1, R2 and R3.

NOTE: The R1, R2, and R3 displays are as follows:
R1 is Shaft Angle as xxx.xx degrees
R2 is Trunnion LOS Angle as xx.xxx degrees
R3 is time as xxx.xx seconds

NOTE: If R2 is not within 00.000 \pm .100 repeat 6.2.11.4.10.

6.2.11.4.11 Compute the respective differences between the R1 and R3 displays recorded in 6.2.11.4.10 as Δ Shaft and Δ Time.

6.2.11.4.12 Compute and record the Shaft slew rate as the ratio degrees/second.

$$\frac{\Delta \text{ Shaft}}{\Delta \text{ Time}}$$

6.2.11.4.13 The Shaft slew rate shall be 17.0 \pm 3.4 degrees/second.

6.2.11.5 Slew Rate - Medium Speed

6.2.11.5.1 Set up Analog Recorders to measure the following signals at the location specified:

- a. CG 3141 TRUN CDU 16X RES ERROR 4A1-A3-7-0
- b. CG 3120 SCT TRUN 1X RES ERROR 4A1-A2-8-0
- c. CG 3130 SCT SHAFT 1/2X RES ERROR 4A3-A2-2-3
- d. CG 3211 SHAFT CDU 16X RES ERROR 4A3-A2-8-2

6.2.11.5.2 Set the CONTROLLER SPEED switch on G&N Indicator Control Panel to MED.

6.2.11.5.3 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lamp extinguishes, return OPTICS MODE selector to MANUAL position.

6.2.11.5.4 Record the SHAFT CDU and 2X TRUNNION CDU indications. The optics CDU readout shall be 000.000 \pm 0.006 degrees.

NOTE: Read and understand section 6.2.11.5.5 before proceeding. Do not hold control stick at upper limit for more than twenty seconds.

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6.2.11.5.5 Insert VERB 06, MOUN 56 and press ENTER on DSKY. Start Analog Recorder chart drive at 5 mm/sec. Push the control stick to its upper limit. Two seconds later press the "MARK" pushbutton. Approximately ten seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick and stop the Analog Recorder. Verify KEY RLSE is lighted and press KEY RLSE on LEB DSKY panel. Immediately record the displays in R1, R2 and R3. In a few seconds (approximately 10 seconds), the displays in R1, R2 and R3 change; record the second displays in R1, R2 and R3.

6.2.11.5.6 Record the value of signals specified in 6.2.11.5.1.

CG 3120 SCT TRUN LX RES ERROR shall be less than 0.200 VRMS

NOTE: The R1, R2, and R3 displays when the KEY RLSE pushbutton is pressed are as follows:
R1 is Shaft Angle as 000.00 \pm 000.10 degrees
R2 is Trunnion LOS Angle as Xx.XXX degrees
R3 is time as XXX.XX seconds

NOTE: If R1 is not within $\pm .10$ repeat 6.2.12.5.5.

6.2.11.5.7 Compute the respective differences between the R2 and R3 displays recorded in 6.2.12.5.5 as Δ Trun, and Δ Time.

6.2.11.5.8 Compute and record the Trunnion slew rate as the ratio degrees/second.

$$\frac{\Delta \text{ Trun}}{\Delta \text{ Time}}$$

6.2.11.5.9 The Trunnion slew rate shall be 1.0 ± 0.2 degrees/second.

6.2.11.5.10 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lamp is extinguished, return selector to MANUAL position.

6.2.11.5.11 Record the SHAFT CDU and 2X TRUNNION CDU indications. The Optics CDU readout shall be 000.000 ± 0.006 degrees.

NOTE: Read and understand section 6.2.11.5.12 before proceeding. Do not hold control stick at right limit for more than ten seconds.

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6.2.11.5.12 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Start Analog Recorder chart drive at 5 mm/sec. Push the control stick to its right limit. Two seconds later press the "MARK" pushbutton. Approximately ten seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick and stop the Analog Recorder. Verify KEY RELEASE is displayed, press KEY RELEASE. IMMEDIATELY record the displays in R1, R2 and R3. In a few seconds (approximately 10 seconds), the displays in R1, R2 and R3 change; record the second displays in R1, R2 and R3.

6.2.11.5.13 Record the value of signal e specified in 6.2.11.5.1.

e) CG 3130 SCT SHAFT LX RES ERROR shall be less than 0.800 VRMS

NOTE: The R1, R2 and R3 displays are as follows:

R1 is Shaft Angle as xxx.xx degrees
R2 is Trunnion LOS Angle as xx.xxx degrees
R3 is Time as xxx.xx seconds

NOTE: If R2 is not within 00.000 \pm .100, repeat 6.2.11.5.12.

6.2.11.5.14 Compute the respective differences between the R1, and R3 displays recorded in 6.2.11.5.12 as Δ Shaft, and Δ Time.

6.2.11.5.15 Compute and record the Shaft slew rate as the ratio degrees/second.

$$\frac{\Delta \text{ Shaft}}{\Delta \text{ Time}}$$

6.2.11.5.16 The Shaft slew rate shall be 2.0 ± 0.2 degrees/second.

6.2.11.6 Slew Rate - Low Speed

6.2.11.6.1 Set the CONTROLLER SPEED switch on G&W Indicator Control Panel to LO.

6.2.11.6.2 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lamp extinguishes, return OPTICS MODE selector to MANUAL position.

6.2.11.6.3 Record the SHAFT CDU and 2X TRUNNION CDU indications. The optics CDU readout shall be 000.000 \pm 0.006 degrees.

NOTE: Read and understand section 6.2.11.6.4 before proceeding. Do not hold control stick at upper limit for more than thirty seconds.

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6.2.11.6.4 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Start Analog Recorder chart drive at 5 mm/sec. Push the control stick to its upper limit. Two seconds later press the "MARK" pushbutton. Approximately ten seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick and stop the Analog Recorder. Verify KEY RLSE is lighted and press KEY RLSE on LEB DSKY panel. Immediately record the displays in R1, R2, and R3. In a few seconds (approximately 10 seconds), the displays in R1, R2 and R3 change; record the second displays in R1, R2 and R3.

6.2.11.6.5 Record the value of signal b) specified in 6.2.12.5.1 of the Medium Speed Test.

b) CG 3120 SCT TRUN LX RES ERROR shall be less than
0.200 VRMS

NOTE: The R1, R2 and R3 displays when the "MARK" pushbutton is pressed are as follows:
R1 is Shaft Angle as 000.00 + 900.10 degrees
R2 is Trunnion LOS Angle as xx.xxx degrees
R3 is Time as xxx.xx seconds

NOTE: If R1 is not within $\pm .10$, repeat 6.2.12.6.4

6.2.11.6.6 Compute the respective differences between the R2 and R3 displays recorded in 6.2.11.6.4 as Δ Trun, and Δ Time.

6.2.11.6.7 Compute and record the Trunnion slew rate as the ratio degrees/second.

$$\frac{\Delta \text{ Trun}}{\Delta \text{ Time}}$$

6.2.11.6.8 The Trunnion slew rate shall be 0.1 ± 0.02 degrees/second.

6.2.11.6.9 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lamp is extinguished return selector to MANUAL position.

6.2.11.6.10 Record the SHAFT CDU and 2X TRUNNION CDU indications. The Optics CDU readout shall be 000.000 ± 0.006 degrees.

NOTE: Read and understand section 6.2.11.6.11 before proceeding. Do not hold control stick at right limit for more than ten seconds.

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6.2.11.6.11 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Start Analog Recorder chart drive at 5 mm/sec. Push the control stick to its right limit. Two seconds later press the "MARK" pushbutton. Approximately ten seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick and stop the Analog Recorder. Verify KEY RLSE is displayed. Press KEY RLSE. IMMEDIATELY record the displays in R1, R2 and R3. In a few seconds (approximately 10 seconds), the displays in R1, R2 and R3 change; record the second displays in R1, R2 and R3.

6.2.11.6.12 Record the value of signals c) and d) specified in 6.2.11.5.1 of the Medium Speed test.

b) CG 3130 SCT SHAFT LX RES ERROR shall be less than 0.200 VRMS

NOTE: The R1, R2 and R3 displays are as follows:
R1 is Shaft Angle as xxx.xx degrees
R2 is Trunnion LOS Angle as xx.xxx degrees
R3 is Time as xxx.xx seconds

NOTE: If R2 is not within 00.000 \pm .10, repeat 6.2.11.6.11.

6.2.11.6.13 Compute the respective differences between the R1 and R3 displays recorded in 6.2.11.6.11 as Δ Shaft, and Δ Time.

6.2.11.6.14 Compute and record the Shaft slew rate as the ratio degrees/second.

$$\frac{\Delta \text{ Shaft}}{\Delta \text{ Time}}$$

6.2.11.6.15 The Shaft slew rate shall be 0.2 \pm 0.04 degrees/second.

6.2.11.7 AGC Optics Slewling

6.2.11.7.1 Set the OPTICS MODE selector to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, set the selector to COMPUTER.

6.2.11.7.2 Set up the Analog Recorder 4A3-A2 to monitor the following signals:

- | | |
|--|------------|
| a. CG 3104, SCT TRUNNION TACH FEEDBACK | 4A3-A2-1-3 |
| b. CG 3115, SCT SHAFT TACH FEEDBACK | 4A3-A2-7-1 |
| c. CG 3134, SCT TRUNNION TACH FEEDBACK | 4A3-A2-4-3 |
| d. CG 3124, SCT SHAFT TACH FEEDBACK | 4A3-A2-3-2 |

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6.2.11.7.3 Enter the following sequence into K148:

- a. VERB 41, NOUN 55, ENTER
- b. +27000, ENTER
- c. +60000, ENTER
- d. VERB 21, NOUN 01, ENTER
- e. 00723, ENTER
- f. 40000 (do not enter)

6.2.11.7.4 Start the Analog Recorder at 10 mm/sec and depress the ENTER button on the K148. Wait until the transients have died out and stop the Analog Recorder. Record the elapsed time for each signal in 6.2.11.7.2 to reach its final value. In all cases, the elapsed time for the signals in 6.2.11.7.2 shall be less than 50 sec.

6.2.11.7.5 Record the SHAFT and 2X TRUNNION CDU dial indications. The SHAFT CDU shall read 270.0 ± 0.022 degrees. The 2X TRUNNION CDU shall read 120.00 ± 0.01 degrees.

6.2.11.7.6 Place the OPTICS MODE selector to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, return the selector to MANUAL.

6.2.11.7.7 Verify that G&N System is in the Coarse Align Mode under Computer control.

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6.2.12 Optics Coordinate Transformation Control Test

6.2.12.1 Proceed with this test if 6.2.4, Operate Power On Test, or 6.2.2.2, Turn On Procedure, has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2, Turn On Procedure, before proceeding with this test.

6.2.12.2 The G&N System shall be in the Coarse Align mode. The COARS ALIGN lamp on the IMU CONTROL Panel shall be the only MODE lamp illuminated.

6.2.12.3 Verify that the TRANSFER switch on the IMU CONTROL Panel is set to COMPUTER.

6.2.12.4 Set the OPTICS MODE selector on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, return the selector to MANUAL.

6.2.12.5 Set the CONTROLLER MODE switch on the G&N Indicator Control Panel to DIRECT.

6.2.12.6 Optics Coordinate Transformation Control Test

6.2.12.6.1 Using the control stick at desired speed, set SHAFT ANGLE CDU to 225.000 degrees and 2X TRUNNION CDU to 10.000 degrees. Set CONTROLLER SPEED to LO to minimize drift.

6.2.12.6.2 Sight through the SCT eyepiece. Move the movable target so it is centered on the SCT reticle pattern. Maintain 2X TRUNNION CDU at 10.000 \pm 0.200 degrees and SHAFT ANGLE CDU at 225.000 \pm 0.200 degrees by manipulating control stick.

6.2.12.6.3 Set the switches on the G&N Indicator Control Panel as follows:

- a. CONTROLLER MODE to RESOLVED
- b. CONTROLLER SPEED to MED

NOTE: The following step will require coordination between the K START and Command Module operators. Each should read and thoroughly understand this step before proceeding.

6.2.12.6.4 Simultaneously sight through the SCT eyepiece, quickly displace the CONTROL STICK 45 degrees in the upper right hand quadrant and press the MARK pushbutton. Record the CRT indication of R3. Observe the viewed object and when it leaves the SCT upper rightfield of view press the MARK pushbutton. Record the CRT indications of R1 and R3. R1 indication shall be 225 \pm 10 degrees and the difference of the R3 indications shall be 30 \pm 6 seconds.

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- 6.2.12.6.5 Set the CONTROLLER MODE switch on the G&N Indicator Control Panel to DIRECT.
- 6.2.12.6.6 Set the OPTICS MODE selector on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, return the selector to MANUAL.
- 6.2.12.7 Mark Pushbutton Test
- 6.2.12.7.1 Using the CONTROL SPICK at desired controller speed, set the SHAFT CDU to 60.000 ± 0.010 degrees and 2X TRUNNION CDU to 30.000 ± 0.010 degrees.
- 6.2.12.7.2 Press the MARK pushbutton on G&N Indicator Control Panel.
- 6.2.12.7.3 Observe VERB 06 HOUN 56 displayed on CRT.
- 6.2.12.7.4 The OPTX counter in R1 shall indicate 06000 ± 00003 . Record the counter from CRT.
- 6.2.12.7.5 The OPTX counter in R2 shall indicate 15000 ± 00014 . Record the counter from CRT.
- 6.2.12.7.6 Set the OPTICS MODE selector on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, return the selector to MANUAL.

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6.2.13 Optics Positional Accuracy Test

- 6.2.13.1 Proceed with this test if 6.2.4, Operate Power On Test, or 6.2.2.2, Turn on Procedure, has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.1, Turn On Procedure, before proceeding.

NOTE: This test requires the use of G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT StLOS in accordance with "Alignment of Optical Target GSE on Spacecraft Process Specification No. MA 0201-5036."

Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.

Insure that qualified personnel are available outside the Spacecraft to take observations and position the retro-reflecting prism.

- 6.2.13.2 G&N System shall be in COARSE ALIGN MODE under AGC control. Optics operate power shall be applied.

- 6.2.13.3 Optics controls on the G&N Indicator Control Panel shall be set as follows:

- a) CONTROLLER SPEED - MED
- b) CONTROLLER MODE - DIRECT
- c) SLAVE TELESCOPE - STAR LOS
- d) OPTICS MODE - ZERO OPTICS

6.2.13.4 Resolution Checks

- 6.2.13.4.1 After ZERO ENCODER lamp has extinguished, set OPTICS MODE switch to MANUAL position.

- 6.2.13.4.2 Sight on the 5 inch Autocollimator, through the SXT eyepiece. Using the CONTROL STICK to drive the SXT to the approximate position, adjust the TRUNNION and SHAFT ANGLE to view the autocollimator resolution pattern at the center of the field of view.

- 6.2.13.4.3 Note that the 5 inch autocollimator resolution pattern contains a series of lines of different thickness and width. Each set of lines is marked with a numeral (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space in seconds of arc. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines.

- 6.2.13.4.3.1 The SXT resolution shall be at least 10 arc seconds at center of field of view.

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- 6.2.13.4.4 Sight through the SCT eyepiece and align the SCT with the control stick until the SCT resolution chart is centered in the field of view, using the SCT and the resolution chart. Record the number of the lowest numbered set distinctly seen with the SCT. The SCT shall demonstrate a resolution of at least 3 arc minutes at center of field of view.
- 6.2.13.5 Slave Telescope Mode Checks
- 6.2.13.5.1 Set OPTICS MODE selector to ZERO OPTICS. After the ZERO ENCODER lamp is extinguished, return selector to MANUAL position. Verify SLAVE TELESCOPE switch is in the STAR LOS position.
- 6.2.13.5.2 Record SCT Shaft and Trunnion Angles on the TPAC and the SHAFT and 2X TRUNNION CDU indications. The difference between TPAC angles and corresponding CDU angles shall be less than 0.5 degrees.
- NOTE: TPAC TRUNNION angle counter reading indicates LOS angles and 2X TRUNNION CDU angle reading indicates 2X LOS angle. The 2X TRUNNION CDU indication must be divided by two before subtracting from SCT TRUNNION display.
- 6.2.13.5.3 Using Control Stick, drive 2X TRUNNION and SHAFT CDU's to 35.500 degrees. Record TPAC shaft angle (35.5 ± 0.5 degrees) and trunnion angle (17.75 ± 0.25 degrees) on the TPAC.
- 6.2.13.5.4 Repeat 6.2.13.5.1
- 6.2.13.5.5 Set SLAVE TELESCOPE Switch to LANDMARK LOS 0°.
- 6.2.13.5.6 Remove the plug from the base of SXT eyepiece. Install the Adapter Assembly and Portable Light Assembly in this location. Turn on the light.
- NOTE: It will be necessary for the optics operator to communicate with the personnel outside the Spacecraft handling the optical GSE (Retroreflecting Prism, Autocollimator, etc.) through 6.2.13.8.2.
- If needed to reduce external light, obtain, place, and secure a photographer's hood over the optics head and the retroreflecting prism.
- 6.2.13.5.7 Sight through the SCT eyepiece and give direction for positioning the Retroreflecting Prism, Model No. A23-200, to span between the SXT StLOS and SCT LOS, so that the illumination from the backlight filament is clearly visible at the center of the field. The prism must be held in this position until after completion of Step 6.2.13.5.12.

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- 6.2.13.5.8 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Adjust the 2X TRUNNION CDU with OPTICS CONTROL Stick to bring the SCT horizontal reticle line into coincidence with the SXT horizontal reticle line. Record the 2X TRUNNION CDU angle. The difference between this angle and the corresponding angle recorded in Step 6.2.13.5.2 shall be less than $\pm .440$ degrees.
- 6.2.13.5.9 Replace the Portable Light in the adapter in the SXT eyepiece.
- 6.2.13.5.10 Readjust the 2X TRUNNION CDU to obtain the values $\pm .002$ degrees recorded in Step 6.2.13.5.2 (at the zero optics position). Then set SLAVE TELESCOPE Switch to STAR LOS.
- 6.2.13.5.11 To temporarily disable the electrical drive to the SCT TRUNNION, carefully unscrew the SCT TRUNNION Manual Drive item until it just releases from the panel. Do not rotate further, as this would displace the SCT LOS from the desired reference position.
- 6.2.13.5.12 Verify that the Retroreflecting Prism is still in the desired position as in Step 6.2.13.5.7 by sighting into the SCT eyepiece. Then remove the Portable Light from the adapter and again direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in Step 6.2.13.5.8. Again observe the positions of the SCT and SXT reticles and adjust the 2X TRUNNION CDU with CONTROLLER Stick to bring the SCT horizontal reticle line into coincidence with the SXT horizontal reticle line. Record the 2X TRUNNION CDU angle. The difference between this angle and the corresponding angle recorded in Step 6.2.13.5.2 shall be less than $\pm .440$ degrees. Replace the Portable Light in the adapter.
- 6.2.13.5.13 Replace the SCT TRUNNION Manual Adjust drive in the panel.
- 6.2.13.5.14 Use the Control Stick to drive the 2X TRUNNION CDU to 50.000 ± 0.005 degrees.
- 6.2.13.5.15 Set SLAVE TELESCOPE Switch to OFFSET 25°. After 30 seconds has elapsed from time of switch operation, record TPAC TRUNNION angle and CDU 2X TRUNNION angle. The difference shall be $25^\circ \pm 0.5$ degrees. Also record CDU SHAFT angle.
- 6.2.13.5.16 To temporarily disable the electrical drive to the SCT TRUNNION and SCT SHAFT, carefully unscrew the SCT TRUNNION and SCT SHAFT Manual Drive item until they just release from the panel. Do not rotate further as this would displace the SCT LOS from the desired reference position.

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- 6.2.13.5.17 For this step it is necessary to reposition the Retroreflecting Prism so that it is inclined at an angle 25° downward in such a position as to span the SCT LOS and the SXT StLOS. After the prism has been moved to the approximate position described above, again sight into the SCT eyepiece and give direction as necessary to adjust the prism position so that the illumination from the backlight filament is again visible at the center of the field. Then remove the Portable Light Assembly (from the SXT eyepiece adapter) and sight through the SXT eyepiece while directing the light assembly into the SCT eyepiece. Again observe the comparison of SCT and SXT reticles. Adjust the 2X TRUNNION CDU and the SHAFT CDU with OPTICS CONTROLLER Stick to bring the two reticle patterns into coincidence. Record the 2X TRUNNION CDU angle and the SHAFT CDU angle. The difference between each of these two angles and the corresponding values recorded in Step 6.2.13.5.5 shall be less than $\pm .440$ degrees.
- 6.2.13.5.18 Replace Portable Light Assembly in the adapter. Set SLAVE TELESCOPE switch to STAR LOS. Set OPTICS MODE selector to ZERO OPTICS. After the ZERO ENCODER lamp is extinguished, return selector to MANUAL position. Verify SLAVE TELESCOPE Switch is in the STAR LOS position. Remove hood (if used) and Retroreflecting Prism.
- 6.2.13.6 Sextant Parallelism Tests
- 6.2.13.6.1 Using Control Stick (with CONTROLLER SPEED switch HI), drive SXT StLOS to 30.000 ± 2.0 degrees as indicated on the 2X TRUNNION CDU.
- 6.2.13.6.2 Insure that SHAFT CDU readout indicates 000.000 ± 0.006 degrees. Use Control Stick to correct it, if required.
- 6.2.13.6.3 Sight through the autocollimator eyepiece and superimpose the sextant horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.
- 6.2.13.6.4 Repeat 6.2.13.6.3 twice and record the average of the three autocollimator readings.
- 6.2.13.6.5 Set OPTICS MODE selector to ZERO OPTICS. Return selector to MANUAL position after ZERO ENCODER lamp is extinguished on the Condition Annunciator Panel.. Insure that 2X TRUNNION CDU readout indicates 000.000 ± 0.002 degrees, and SHAFT ANGLE CDU indicates $000.000 \pm .006$ degrees. Correct if necessary. Record 2X TRUNNION and SHAFT CDU indications.

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- 6.2.13.6.6 Again sight through 5 inch autocollimator eyepiece and adjust the horizontal filar (not autocollimator) to bring StLOS horizontal reticle line and filar horizontal image to coincidence. Record the average of three filar position indications. This reading shall not differ from that obtained in 6.2.13.6.4 by more than 15 arc seconds.
- 6.2.13.7 Shaft and Trunnion Positional Accuracy Checks
- 6.2.13.7.1 Set OPTICS MODE selector to ZERO OPTICS. Return selector to MANUAL position after ZERO ENCODER lamp is extinguished.
- 6.2.13.7.2 Enter VERB 41, NOUN 55 into the K- 148. Press ENTER pushbutton. The VERB-NOUN display shall indicate 21-57 flashing on CRT.
- 6.2.13.7.3 Enter 00400 into the K- 148. Press ENTER pushbutton. Enter 00200 into the K- 148. Press ENTER pushbutton. The VERB-NOUN display on CRT shall stop flashing.
- 6.2.13.7.4 Enter VERB 14, NOUN 55 into K- 148. Press ENTER pushbutton. Record the value of the SHAFT and TRUNNION CDU counters in R1 and R2 on CRT.
- 6.2.13.7.5 Record SHAFT and 2X TRUNNION CDU indications.
- 6.2.13.7.6 Set OPTICS MODE selector to ZERO OPTICS. After ZERO ENCODER lamp is extinguished, return selector to MANUAL.
- 6.2.13.7.7 Using Optics Hand Controller, set SHAFT and 2X TRUNNION CDU's to the values recorded in 6.2.13.1.8.
- 6.2.13.7.8 Record the value of the SHAFT and TRUNNION CDU counters in R1 and R2 on CRT.
- 6.2.13.7.8.1 The values of 6.2.13.7.8 shall differ from those of 6.2.13.7.4 by no more than ± 00005 .
- NOTE: Read and understand 6.2.14.7.11 before proceeding.
- 6.2.13.7.9 Sight through the SXT. Using Control Stick, align the SXT StLOS with optical target No. 1 (approximately 2X TRUNNION 106.650 degrees, SHAFT ANGLE 118.500 degrees) on the G&W Installation Qualification Fixture Model No. A23-071. At the instant of coincidence, simultaneously press "MARK" pushbutton and read the SHAFT TRUNNION CDU indication.
- NOTE: VERB 06, NOUN 56 shall appear on DSKY indicating optical CDU and time displays.
- 6.2.13.7.10 Record the SHAFT angle as indicated on R1 and TRUNNION angle as indicated on R2 of LEB DSKY. Record the SHAFT and 2X TRUNNION CDU indication.

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- 6.2.13.7.10.1 Repeat 6.2.13.7.9 through 6.2.13.7.10 two more times. If two of the specific recorded angles are equal, record this angle. If all three of the recorded angles are different, select the value that is between the higher and lower values.
- 6.2.13.7.11 Sight through the SXT. Using Control Stick, align the SXT StLOS with Optical Target No. 2 (approximately 2X TRUNNION 106.650 degrees and SHAFT ANGLE 241.500 degrees) on A23-071. At the instant of coincidence, simultaneously press "MARK" pushbutton and read SHAFT and TRUNNION CDU.
- NOTE: VERB 06, NOUN 56 shall appear on DEKY.
- 6.2.13.7.12 Record the SHAFT angle as indicated on R1 and TRUNNION angle as indicated on R2 of LEB DEKY. Record the SHAFT and 2X TRUNNION CDU indication.
- 6.2.13.7.12.1 Repeat 6.2.13.7.11 through 6.2.13.7.12 two more times. If two of the specific recorded angles are equal, record this angle. If all three of the recorded angles are different, select the value that is between the higher and lower values.
- 6.2.13.7.13 Set OPTICS MODE selector to ZERO OPTICS. After the ZERO ENCODER lamp is extinguished, set selector to COMPUTER position.
- 6.2.13.7.14 Enter VERB 41, NOUN 55 into K- 148. Press ENTER pushbutton. VERB-NOUN display shall flash 21-57.
- 6.2.13.7.15 Enter the value recorded from R1 in 6.2.13.7.10.1 into K- 148. Press ENTER pushbutton.
- 6.2.13.7.16 Enter the value recorded from R2 in 6.2.13.7.10.1 into K- 148. Press ENTER pushbutton.
- 6.2.13.7.17 Sight through the SXT. The StLOS should be centered on Optical Target No. 1 on A23-071. Record SHAFT and 2X TRUNNION CDU indications.
- 6.2.13.7.18 Enter VERB 41, NOUN 55 into K- 148. Press ENTER pushbutton. VERB-NOUN displays shall flash 21-57.
- 6.2.13.7.19 Enter the value recorded from R1 in 6.2.13.7.12.1 into the K- 148. Press ENTER pushbutton.
- 6.2.13.7.20 Enter the value recorded from R2 in 6.2.13.7.12.1 into the K- 148. Press ENTER pushbutton.
- 6.2.13.7.21 Sight through the SXT. The StLOS should be centered on Optical Target No. 2 on A23-071. Record SHAFT and 2X TRUNNION CDU indications.

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- 6.2.13.7.22 The difference between the SHAFT CDU indications from 6.2.13.7.10.1 and 6.2.13.7.17 shall not exceed 0.025 degrees. Record this difference.
- 6.2.13.7.22.1 The difference the 2X TRUNNION CDU indications from 6.2.13.7.10.1 and 6.2.13.7.17 shall not exceed 0.025 degrees. Record this difference.
- 6.2.13.7.22.2 The difference between the SHAFT CDU indications from 6.2.13.7.12.1 and 6.2.13.7.21 shall not exceed 0.025 degrees. Record this difference.
- 6.2.13.7.22.3 The difference between the 2X TRUNNION CDU indications from 6.2.13.7.12.1 and 6.2.13.7.21 shall not exceed 0.025 degrees. Record this difference.
- 6.2.13.8 SXT STLOS-LLOS Parallelism Test, 90 Degree Position
- 6.2.13.8.1 Set the OPTICS MODE selector to ZERO OPTICS position. After the ZERO ENCODER lamp is extinguished, set selector to MANUAL position.
- 6.2.13.8.2 Set CONTROLLER SPEED to MEDIUM. Set OPTICS HOLD to OFF. Using Control Stick, drive the SXT TRUNNION axis until the 2X TRUNNION CDU indicates 175 ± 5 degrees.
- 6.2.13.8.3 Set CONTROLLER SPEED to LO and drive the 2X TRUNNION CDU until it indicates 180.000 degrees. Insure that the SHAFT CDU indicates 0.000 ± 0.006 degrees.
- 6.2.13.8.4 If necessary, cover the optics head with a photographer's hood (or any acceptable substitute) to block stray light from the sextant head.
- 6.2.13.8.5 Turn on SXT Portable Light Assembly
- 6.2.13.8.6 Sight through the SXT. Two reticle patterns shall be visible. Use the Optics Hand Controller to adjust the SXT TRUNNION axis until the two horizontal reticle lines are coincident. Record the 2X TRUNNION angle.
- 6.2.13.8.6.1 The 2X TRUNNION CDU shall indicate 180.000 ± 0.020 degrees.
- 6.2.13.8.7 Remove the Portable Light Assembly and Adapter Assembly from the base of the SXT eyepiece. Replace Sextant eyepiece plug.
- 6.2.13.9 Set OPTICS MODE selector to ZERO OPTICS. After the ZERO ENCODER lamp is extinguished on the Condition Annunciator Panel, return selector to MANUAL position.
- 6.2.13.10 Verify that the SHAFT CDU and 2X TRUNNION CDU indications on the OPTICS CDU readout indicate 000.000 ± 0.006 degrees.

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6.2.14 AGC Mode Control Test

6.2.14.1 Proceed with this test if 6.2.4 Operate Power on Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2 Turn On Procedure.

6.2.14.2 Verify that the TRANSFER switch is set to COMPUTER and COARSE ALIGN is the only mode lamp lighted.

6.2.14.3 Verify that the MODE pushbutton on the IMU CONTROL panel will not effect a mode change by pressing each button not lighted. The COARS ALIGN MODE lamp shall remain lighted.

6.2.14.4 Zero Encode Mode

6.2.14.4.1 Enter VERB 25, NOUN 22 into K- 148. Press the ENTER pushbutton.

6.2.14.4.2 Enter +04000 into K- 148. Press the ENTER pushbutton.

6.2.14.4.3 Enter +04000 into K-148. Press the ENTER pushbutton.

6.2.14.4.4 Enter +04000 into K- 148. Press the ENTER pushbutton.

6.2.14.4.5 Wait 30 seconds.

NOTE: Perform 6.2.14.4.6 through 6.2.14.4.10 within 30 seconds.

6.2.14.4.6 Enter VERB 40, NOUN 20 into K- 148. Press the ENTER pushbutton.

6.2.14.4.7 Verify the K Relays on CRT indicate 001001 immediately after pushing ENTER pushbutton. Record.

6.2.14.4.8 Verify that the INNER, MIDDLE, and OUTER Gimbal CDU's indicate 000.000 \pm 1.00 degrees. Record.

6.2.14.4.9 Enter VERB 15, NOUN 20 into K- 148. Press the ENTER pushbutton.

NOTE: (a) KEY RELEASE and CHECK FAIL will be lighted. Press KEY RELEASE on DSKY.

(b) CDU FAIL will momentary lighted on Condition Annunciator Panel.

6.2.14.4.10 Verify that the contents of R1, R2, and R3 on CRT indicate all zeros. Record.

6.2.14.4.11 Verify ZERO ENCODER on Condition Annunciator Panel has extinguished before proceeding.

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6.2.14.5 Coarse Align Mode

6.2.14.5.1 Enter VERB 41, NOUN 20 into K-148. Press the ENTER pushbutton.

6.2.14.5.2 Enter +00000 into K-148. Press the ENTER pushbutton.

6.2.14.5.3 Enter +00000 into K-148. Press the ENTER pushbutton.

6.2.14.5.4 Enter +00000 into K-148. Press the ENTER pushbutton. Wait 60 seconds.

NOTE: The PGNS lamp will light on the Condition Annunciator Panel. Disregard lamp indication.

6.2.14.5.5 Set up the Analog Recorders 4A1-A2 and 4A3-A2 to monitor the following signals:

	Signal	Analog Recorder
a.	CG 2110 IGA TORQUE MOTOR INPUT	4A3-A2
b.	CG 2140 MGA TORQUE MOTOR INPUT	4A3-A2
c.	CG 2170 OGA TORQUE MOTOR INPUT	4A3-A2

6.2.14.5.6 Enter (and verify) VERB 41, NOUN 20 (COURSE ALIGN) into K-148. Press ENTER pushbutton.

6.2.14.5.7 Enter +06000 into K-148 twice. Press ENTER pushbutton after each entry.

6.2.14.5.8 Start Analog Recorder 4A3-A2. Enter +06000 into K-148. Press ENTER pushbutton.

NOTE: The GIMBAL LOCK lamps on the Condition Annunciator Panel and on Event Modules may light. Disregard these lamp indications unless specifically indicated to do otherwise.

6.2.14.5.9 After the transients have died out, stop Analog Recorder 4A3-A2. Determine the time elapsed on each signal specified in 6.2.14.5.5 between the initial and final transients. Record elapsed times. The elapsed times for IGA, OGA, and MGA to drive from zero degrees to 60 degrees shall be no greater than 21 seconds.

6.2.14.5.10 Verify that the K Relays on CRT indicate 000010. Record.

6.2.14.5.11 Record IMU-CDU DIFFERENCE meter indications for the INNER, MIDDLE, and OUTER GIMBAL channels. The INNER, MIDDLE, and OUTER indicators in the IMU-CDU DIFFERENCE meter shall be 0. \pm 1.0 degrees.

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- 6.2.14.5.12 Record the indicated value of the following signals in Table VII on the CRT.

Table VII Signal Voltage Requirements

	<u>Signals</u>	<u>Requirements</u>
1.	CG 2206 IGA CDU IX RES ERROR	0.0 to .210 VRMS
2.	CG 2236 MGA CDU IX RES ERROR	0.0 to .210 VRMS
3.	CG 2266 OGA CDU IX RES ERROR	0.0 to .210 VRMS
4.	INNER GIMBAL ANGLE	60 \pm 2.5 degrees
5.	MIDDLE GIMBAL ANGLE	60 \pm 2.5 degrees
6.	OUTER GIMBAL ANGLE	60 \pm 2.5 degrees
7.	CG 2209 SCS PITCH	0.0 \pm 1.00 degrees
8.	CG 2239 SCS YAW BODY AXIS	0.0 \pm 1.00 degrees
9.	CG 2241 SCS YAW OFFSET AXIS	0.0 \pm 1.00 degrees
10.	CG 2269 SCS ROLL BODY AXIS	0.0 \pm 1.00 degrees
11.	CG 2271 SCS ROLL OFFSET AXIS	LLL to UUU degrees

6.2.14.6 Fine Align Mode

NOTE: GIMBAL LOCK may be on during the duration of FINE Align Mode test.

- 6.2.14.6.1 Enter (and verify) VERB 42 into K-148. Press ENTER pushbutton to advance G&N to the FINE ALIGN mode. The VERB-NOUN display shall indicate 21-67 flashing.

- 6.2.14.6.2 Enter +100000 three times pressing ENTER pushbutton after each entry into K-148. Press ENTER pushbutton. Verify VERB-NOUN display shall stop flashing. The FINE ALIGN MODE lamp on the IMU CONTROL Panel is the only MODE lamp that is lighted.

- 6.2.14.6.3 Record the indicated values of the following signals in Table VIII on the CRT.

Table VIII Voltage Requirements

	<u>Signals</u>	<u>Requirements</u>
a.	CG 2204 IGA CDU 16X RES ERROR	0.0 to .200 VRMS
b.	CG 2234 MGA CDU 16X RES ERROR	0.0 to .200 VRMS
c.	CG 2264 OGA CDU 16X RES ERROR	0.0 to .200 VRMS
d.	CG 2107 OGA SERVO ERROR	0.0 to .36 VRMS
e.	CG 2137 MGA SERVO ERROR	0.0 to .36 VRMS
f.	CG 2167 OGA SERVO ERROR	0.0 to .36 VRMS

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6.2.14.6.3 (Continued) Table LLL Voltage Requirements

	<u>Signals</u>	<u>Requirements</u>
g.	CG 2209 SCS PITCH	0 \pm 1.00 degrees
h.	CG 2239 SCS YAW BODY AXIS	0 \pm 1.00 degrees
i.	CG 2241 SCS YAS OFFSET AXIS	0 \pm 1.00 degrees
j.	CG 2269 SCS ROLL BODY AXIS	0 \pm 1.00 degrees
k.	CG 2271 SCS ROLL OFFSET AXIS	LLL to UUU degrees

6.2.14.6.4 Record the INNER, MIDDLE, and OUTER GIMBAL CDU indications. The INNER, MIDDLE, and OUTER indicator on the IMU-CDU DIFFERENCE meter shall be 0.0 \pm 1.0 degrees.

6.2.14.6.5 Verify that the K-RELAYS on CRT indicate 001000.

6.2.14.6.6 Insert the following into LEB DECK.

- Insert VERB 41, NOUN 20 ENTER.
- Insert +00000, ENTER.
- Insert +00000, ENTER.
- Insert +00000, ENTER.
- Wait 60 seconds.

6.2.14.7 Attitude Control Mode

6.2.14.7.1 Ensure that the SCS is in one of the non G&N modes.

6.2.14.7.2 Obtain G&N Overall Polarity Tape FO4CO 14-K00019-00 and load the tape on TAPE READER, Console 4A4-A3-K148.

NOTE: This tape is to be used with all SUNSPOT program assemblies to verify the phasing and installation of the G&N System into the Apollo Spacecraft. Attitude and attitude error signals, generated under AGC Control are verified as to magnitude and polarity.

NOTE not valid for Corona Program Assembly.

6.2.14.7.3 Set the POWER/ON switch on the TAPE READER 4A4-A2 to ON.

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6.2.14.7.4 Perform the following steps on Console 4A4-A3 in sequence:

- a. Press the TAPE/KEY indicator to TAPE.
- b. Press the FWD/REV indicator to FWD.
- c. Press the IND/CONT indicator to CONT.
- d. Press the LOAD/INH indicator to LOAD.

NOTE: This Section initializes the AOC, loads the Theta-D update, ERSATZV36, entry Theta-D and nightwatchman alarm reset programs into AOC E-Memory, then advances the G&N System to the ZERO ENCODE Mode.

- e. Press the RUN indicator switch to RUN. Wait 90 seconds after tape stops before proceeding for ZERO ENCODE to extinguish.

6.2.14.7.5 Pitch Error (+5° and -5°)

6.2.14.7.5.1 Press the RUN indicator switch to RUN. Wait until tape stops.

6.2.14.7.5.2 Verify R1 indicates 00001 on CRT.

6.2.14.7.5.3 Enter the code 2 013 000 000 into C-START Module 4A1-A5-C156. press the XEQ/SEAL pushbutton to call up CG 2209 SCS PITCH ERROR on 4A1-A3-CHI.

6.2.14.7.5.4 Press 5mm/sec on Analog Recorder 4A1-A3.

NOTE: The readings on Recorder must be taken immediately after the transients have died out.

6.2.14.7.5.5 Press the RUN indicator switch on 4A4-k148 to RUN. Wait until tape stops.

6.2.14.7.5.6 After transients have died out, stop the recorder (4A1-A3). Record the magnitude of the initial value (0 + 1.00 degrees) and the final value (+5, +1.37, -1.23 degrees) of CG 2209. Record the phase.

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6.2.14.7.5.7 Record the values of the following signals in Table IX on the CRT. Be sure to record the associated sign.

Table IX Signal Requirements

<u>Signals</u>	<u>Requirements</u>
a. CG 2209 SCS PITCH	+5, +1.37, -1.23 degrees
b. CG 2239 SCS YAW BODY	0.0 \pm 1.00 degrees
c. CG 2241 SCS YAW OFFSET	0.0 \pm 1.00 degrees
d. CG 2269 SCS ROLL BODY	0.0 \pm 1.00 degrees
e. CG 2271 SCS ROLL OFFSET	UUU to LLL degrees

6.2.14.7.5.8 Record the value of the pitch channel of the IMU-CDU DIFFERENCE Meter. The INNER indicator or the IMU-CDU DIFFERENCE METER shall be -5 \pm 1.0 degrees.

6.2.14.7.5.9 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.14.7.5.10 Verify R1 indicates 00002 on CRT.

6.2.14.7.5.11 Start Analog Recorder 4A1-A3 chart drive at 5 mm/sec.

NOTE: The readings on the Recorder 6.2.14.7.5.13 and CRT 6.2.14.7.5.14 must be taken immediately after transients have died out.

6.2.14.7.5.12 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.14.7.5.13 After the transients have died out, stop recorder 4A1-A3. Record the magnitude of the initial (0 \pm 1.00) and the final value (-5, +1.23, -1.37 degrees) of CG 2209 SCS Pitch Error. Record phase.

6.2.14.7.5.14 Record the values of the following signals in Table X on the CRT.

Table X Signal Requirements

<u>Signal</u>	<u>Requirements</u>
a. CG 2209 PITCH ERROR	-5, +1.23, -1.37 degrees
b. CG 2239 SCS YAW BODY	0.0 \pm 1.00 degrees
c. CG 2241 SCS YAW OFFSET	0.0 \pm 1.00 degrees
d. CG 2269 SCS ROLL BODY	0.0 \pm 1.00 degrees
e. CG 2271 SCS ROLL OFFSET	UUU to LLL degrees

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6.2.14.7.6.10 Verify R1 indicator 00004 on CRT.

6.2.14.7.6.11 Start Analog Recorder 4A1-A3 chart drive at 5 mm/sec.

NOTE: The readings on the Recorder and CRT must be taken immediately after the transients have died out.

6.2.14.7.6.12 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.14.7.6.13 After the transients have died out, stop recorder 4A1-A3. Record the initial (0 ± 1.00 degrees) and final (-4.20 ± 1.18 , -1.32 degrees) values of CG 2239 SCS YAW BODY ERROR on the high rate channel.

6.2.14.7.6.14 Record the value of the following signals in Table XII on CRT.

Table XII Signal Requirements

Signals	Requirements
a. CG 2209 SCS PITCH ERROR	0 ± 1.00 degrees
b. CG 2239 SCS YAW BODY	-4.20 , $+1.18$, -1.32 degrees
c. CG 2241 SCS YAW OFFSET	-5.00 , $+1.23$, -1.37 degrees
d. CG 2269 SCS ROLL BODY	-2.70 , $+1.11$, -1.23 degrees
e. CG 2271 SCS ROLL OFFSET	LLL to UUU degrees

6.2.14.7.6.15 Record indications on the MIDDLE GIMBAL channel of the IMU-CDU DIFFERENCE Meter. The MIDDLE indicator on the IMU-CDU DIFFERENCE Meter shall be $+5.0 \pm 1.0$ degrees. Record phase.

6.2.14.7.7 Roll Error ($+5.0$ and -5.0 degrees)

6.2.14.7.7.1 Enter the code 2 022 000 000 into C-START Module 4A1-A5-C156. Press the ZEQ/SEAL pushbutton to call up CG 2269 SCS ROLL BODY Error on 4A1-A3-CH1 or 2.

6.2.14.7.7.2 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.14.7.7.3 Verify R1 indicator 00005 on CRT.

6.2.14.7.7.4 Start Analog Recorder 4A1-A3 at a chart speed of 5 mm/sec.

NOTE: The readings on the Recorder and CRT must be taken immediately after the transients have died out.

6.2.14.7.7.5 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

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6.2.14.7.5.15 Record the value of the PITCH channel of the IMU-CDU DIFFERENCE Meter. The INNER indicator on the IMU-CDU DIFFERENCE Meter shall be $+5 \pm 1.0$ degrees.

6.2.14.7.6 Yaw Error (+5.0 and -5.0 degrees)

6.2.14.7.6.1 Enter the code 2 015 000 000 into C-START Module 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2239 SCS YAW BODY ERROR on 4A1-A3-CHI.

6.2.14.7.6.2 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.14.7.6.3 Verify R1 indicator 00003 on CRT.

6.2.14.7.6.4 Start Analog Recorder 4A1-A3 chart drive at 5 mm/sec.

NOTE: The readings on the Recorder 6.2.14.7.6.6 and CRT 6.2.14.7.6.7 must be taken immediately after the transients have died out.

6.2.14.7.6.5 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.14.7.6.6 After the transients have died out, stop recorder 4A1-A3. Record the initial (0 ± 1.00 degrees) and final ($+4.20$, $+1.32$, -1.18 degrees) values of CG 2239 SCS YAW BODY. Record phase angles.

6.2.14.7.6.7 Record the value (including sign) of the following signals in Table XI on the CRT.

Table XI

Signal Requirements

<u>Signals</u>	<u>Requirements</u>
a. CG 2209 SCS PITCH ERROR	0 ± 1.00 degrees
b. CG 2239 SCS YAW BODY	$+4.20$, $+1.32$, -1.18 degrees
c. CG 2241 SCS YAW OFFSET	$+5.00$, $+1.37$, -1.23 degrees
d. CG 2269 SCS ROLL BODY	$+2.70$, $+1.23$, -1.11 degrees
e. CG 2271 SCS ROLL OFFSET	LLL to UUU

6.2.14.7.6.8 Record indications on MIDDLE GIMBAL channel of the IMU-CDU DIFFERENCE Meter. The MIDDLE indicator on the CDU-IMU DIFFERENCE Meter shall be -5.0 ± 1.0 degrees.

6.2.14.7.6.9 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

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6.2.14.7.7.6 After the transients have died out, stop recorder 4A1-A3. Record the initial (0 \pm 1.00 degrees) and final (+4.20, +1.32, -1.18 degrees) values of CG 2269, SCS ROLL BODY ERROR on the high rate channel. Record phase.

6.2.14.7.7.7 Record the value (including the sign) of the signals specified on the CRT and shown in Table XIII.

Table XIII Signal Requirements

<u>Signals</u>	<u>Requirements</u>
a. CG 2209 SCS PITCH ERROR	0 \pm 1.00 degrees
b. CG 2239 SCS YAW BODY	-2.70, +1.11, -1.23 degrees
c. CG 2241 SCS YAW OFFSET	0 \pm 1.00 degrees
d. CG 2269 SCS ROLL BODY	+4.20, +1.32, -1.18 degrees
e. CG 2271 SCS ROLL OFFSET	+UUU degrees

6.2.14.7.7.8 Record indications of the OUTER GIMBAL channel of the IMU-CDU DIFFERENCE Meter. The OUTER GIMBAL indicator on the IMU-CDU DIFFERENCE Meter shall be -5.0 \pm 1.0 degrees.

6.2.14.7.7.9 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.14.7.7.10 Verify R1 indicator 00006 on CRT.

6.2.14.7.7.11 Start Analog Recorder 4A1-A3 at a chart speed of 5 mm/sec.

NOTE: The readings on the Recorder and CRT must be taken immediately after the transients have died out.

6.2.14.7.7.12 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.14.7.7.13 After the transients have died out, stop recorder 4A1-A3. Record the initial (0 \pm 1.00 degrees) and final (-4.20, +1.18, -1.32 degrees) of CG 2269, SCS ROLL BODY ERROR on the high rate channel. Record phase.

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- 6.2.14.7.7.14 Record the value (including the sign) of the following signals in Table XIV on the CRT.

Table XIV Signal Requirements

<u>Signals</u>	<u>Requirements</u>
a. CG 2209 SCS PITCH ERROR	0 \pm 1.00 degrees
b. CG 2239 SCS YAW BODY	+2.70, +1.23, -1.11 degrees
c. CG 2241 SCS YAW OFFSET	0 \pm 1.00 degrees
d. CG 2269 SCS ROLL BODY	-4.20, +1.18, -1.32 degrees
e. CG 2271 SCS ROLL OFFSET	-LLL degrees

- 6.2.14.7.7.15 Record indications of the OUTER GIMBAL channel of the IMU-CDU DIFFERENCE Meter. The OUTER GIMBAL indicator on the IMU-CDU DIFFERENCE Meter shall be $\pm 5.0 \pm 1.0$ degrees.

- 6.2.14.7.8 Verify that the K-RELAYS on CRT indicates 010000.

- 6.2.14.8 Entry Mode

- 6.2.14.8.1 Yaw Offset Error (+5 degrees)

- 6.2.14.8.1.1 Enter the code 2 016 000 000 into C-START Mode 4A1-A5-C156. Press XEQ/SEAL pushbutton to call up CG 2241 SCS YAW OFFSET ERROR on 4A1-A4-CH1 or 2.

- 6.2.14.8.1.2 Press the RUN indicator switch on 4A4-A3-K148 to RUN. Wait until tape stops.

- 6.2.14.8.1.3 Verify R1 indicator 00007 on CRT.

- 6.2.14.8.1.4 Start Analog Recorder 4A1-A3 chart drive at 5 mm/sec.

NOTE: The readings on the recorder and CRT must be taken immediately after the transients have died out.

- 6.2.14.8.1.5 Press the RUN indicator switch on 4A4-A3-K148 to RUN. Wait until tape stops.

- 6.2.14.8.1.6 After the transients have died out stop recorder 4A1-Ae and record the initial (0 \pm 1.00 degrees) and final (+5.0, +1.37, -1.23 degrees) of CG 2241 YAW OFFSET ERROR on the high rate channel. Record phase.

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- 6.2.14.8.1.7 Record the amplitude (and sign) of the following signals in Table XV on the CRT.

Table XV Signal Requirements

Signals	Requirements
a. CG 2209 SCS PITCH ERROR	0.00 \pm 1.00 degrees
b. CG 2239 SCS YAW BODY	+4.20, +1.32, -1.18 degrees
c. CG 2241 SCS YAW OFFSET	+5.0, +1.37, -1.23 degrees
d. CG 2271 SCS ROLL OFFSET	LLL to UUU degrees

- 6.2.14.8.1.8 Record indications of the MIDDLE GIMBAL channel of the IMU-CDU DIFFERENCE Meter. The MIDDLE GIMBAL indicator of the IMU-CDU DIFFERENCE Meter shall be -5.0 ± 1.0 degrees.

- 6.2.14.8.2 Roll Offset Error (+5 degrees)

- 6.2.14.8.2.1 Enter the code 2 024 000 000 into C-START Module 4A1-A5-C156. Press EXQ/SEAL pushbutton to call up CG 2271 SCS ROLL OFFSET ERROR on 4A1-A3-CH1 or 2.

- 6.2.14.8.2.2 Press the RUN indicator switch on 4A4-A3-K148 to RUN. Wait until tape stops.

- 6.2.14.8.2.3 Verify R1 indicates 00008.

- 6.2.14.8.2.4 Start Analog Recorder 4A1-A3 chart drive at 5 mm/sec.

NOTE: At the end of tape reading the IMU will be in FINE ALIGN Mode for 100 seconds. The IMU will then proceed to ENTRY Mode. The readings on the recorder 6.2.14.8.2.6 and CRT 6.2.14.8.2.7 must be taken immediately after the transients have died out.

- 6.2.14.8.2.5 Press the RUN indicator switch on 4A4-A3-K148 to RUN. Wait until tape stops.

- 6.2.14.8.2.6 After the transients have died out, stop recorder 4A1-A3 and record the initial (0 \pm 1.00 degrees) and final (+5.00, +1.62, -1.38 degrees) of CG 2271 SCS ROLL OFFSET ERROR on the high rate channel. Record phase.

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6.2.14.8.2.7 Record the value (including the sign) of each of the following signals in Table XVI monitored on the CRT.

Table XVI Signal Requirements

<u>Signals</u>	<u>Requirements</u>
a. CG 2209 SCS PITCH ERROR	0 ± 1.00 degrees
b. CG 2239 SCS YAW BODY ERROR	$+0.17, +1.09, -0.05$ degrees
c. CG 2241 SCS YAW OFFSET ERROR	0 ± 1.00 degrees
d. CG 2271 SCS ROLL OFFSET ERROR	$+5.00, +1.62, -1.38$ degrees

6.2.14.8.2.8 Record the indications on all channels of the IMU-CDU DIFFERENCE Meter. The OUTER and INNER values shall be 0.0 ± 1.0 degrees. MIDDLE value shall be 0.30 ± 1.0 degrees.

6.2.14.8.3 Pitch Error (+5 degrees)

6.2.14.8.3.1 Enter the code 2 013 000 000 into C-START 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2209 SCS PITCH on 4A1-A3-CH1.

6.2.14.8.3.2 Press the RUN indicator switch on 4A4-A3-K148 to RUN. Wait until tape stops.

6.2.14.8.3.3 Verify R1 indicator 00009.

6.2.14.8.3.4 Start Analog Recorder 4A1-A3 chart drive at 5 mm/sec.

NOTE: The readings on the recorder 6.2.14.8.3.6 and CRT 6.2.14.8.3.7 must be taken immediately after the transients have died out.

6.2.14.8.3.5 Press the RUN indicator switch on 4A4-A3-K148 to RUN. Wait until tape stops.

6.2.14.8.3.6 After the transients have died out stop recorder 4A1-A3 and record the initial (0 ± 1.00 degrees) and final ($+5.0, +1.37, -1.23$ degrees) of CG 2209 SCS PITCH ERROR on the high rate channel. Record phase.

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- 6.2.14.8.3.7 Record the value of the following signals in Table XVII on the CRT.

Table XVII Signal Requirements

<u>Signal</u>	<u>Requirements</u>
a. CG 2209 SCS PITCH ERROR	+5.0, +1.37, -1.23 degrees
b. CG 2239 SCS YAW BODY	0 + 1.00 degrees
c. CG 2241 SCS YAW OFFSET	0 + 1.00 degrees
d. CG 2271 SCS ROLL OFFSET	LIL to UUU degrees

- 6.2.14.8.4 The INNER GIMBAL on IMU-CDU DIFFERENCE Meter shall be -5.0 ± 1.0 degrees.

- 6.2.14.8.5 Verify that the K-RELAYS on CRT-P17B-L19 indicates 100000.

- 6.2.14.8.6 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

- 6.2.14.8.7 Verify COARS ALIGN mode lamp is the only mode lighted on the IMU-CDU CONTROL PANEL.

- 6.2.14.8.8 Verify OUTER, INNER, and MIDDLE GIMBAL angles on the CDU panel indicate 0.0 ± 0.100 degrees.

- 6.2.15 Gimbal Friction Test

- 6.2.15.1 Obtain the Gimbal Friction Test Tape No. F04C014-K00031-00 and install on TAPE READER.

- 6.2.15.2 Set the POWER/ON Switch on the TAPE READER 4A4-A2 to ON. Perform the following steps on Console 4A4-A3 in sequence:

- a. Press the TAPE/KEY indicator to TAPE.
- b. Press the FWD/REV indicator to FWD.
- c. Press the IND/CONT indicator to CONT.
- d. Press the LOAD/INH indicator to LOAD.

- 6.2.15.3 Set up Analoge Recorder 4A1-A3 to monitor the following signals:

- a. CG 2110 IGA TM IN
- b. CG 2140 MGA TM IN
- c. CG 2170 OGA TM IN

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- 6.2.15.4 Press RUN indicator on K-148. Wait 90 seconds after tape stops.
- 6.2.15.5 Press RUN indicator on K-148. Wait 60 seconds after tape stops.
- 6.2.15.6 Press RUN indicator on K-148. Wait for tape to stop.
- 6.2.15.7 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 to initiate IG Clockwise Friction Test. After about 9 minutes observe, CRT. When IG CDU angle indication stops changing, stop analog recorder. IG CDU angle should be 000 ± 010 degrees.
- 6.2.15.8 Repeat 6.2.15.5 and 6.2.15.6.
- 6.2.15.9 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 to initiate IG Counter clockwise Friction Test. After about 9 minutes observe CRT. When IG CDU angle stops changing, stop analog recorder. IG CDU angle should be 000 ± 010 degrees.
- 6.2.15.10 Repeat 6.2.15.5 and 6.2.15.6.
- 6.2.15.11 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 to initiate OG Clockwise Friction Test. After about 9 minutes, observe CRT. When OG CDU angle stops changing, stop analog recorder. OG CDU angle should be 000 ± 010 degrees.
- 6.2.15.12 Repeat 6.2.15.5 and 6.2.15.6.
- 6.2.15.13 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 to initiate OG Counter-clockwise Friction Test. After about 9 minutes, observe CRT. When OG CDU angle stops changing, stop analog recorder. OG CDU angle should be 000 ± 010 degrees.
- 6.2.15.14 Repeat 6.2.15.5 and 6.2.15.6.
- 6.2.15.15 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 50 initiate MG Clockwise Friction Test. After about 3 minutes, observe CRT. When MG CDU angle stops changing, stop analog recorder. MG CDU angle should be $+050 \pm 010$ degrees.
- 6.2.15.16 Repeat 6.2.15.5 and 6.2.15.6.
- 6.2.15.17 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 to initiate MG Counter-clockwise Friction Test. After about 3 minutes, observe CRT. When MG CDU angle stops changing, stop analog recorder. MG CDU angle should be $+310 \pm 010$ degrees.

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- 6.2.15.18 Press RUN indicator on K- 148. Wait for tape to stop and remove from TAPE READER.
- 6.2.15.19 Observe the six active traces on the analog recorder. Determine that none of the traces indicate greater than 7.5 VDC for a period not to exceed 5MM throughout the range of the active trace.

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6.2.16 Stabilization Loop Step Response Test

6.2.16.1 Proceed with this test if 6.2.4, Operate Power On Test has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2 Turn On Procedures before proceeding. Ensure that the Carry-on Command Stimuli Unit, Model No. C14-200, is installed and connected.

6.2.16.2 Ensure G&N System is in the COARSE ALIGN mode under AGC control.

6.2.16.3 Set the TRANSFER switch on the IMU CONTROL Panel to COMPUTER.

Note: The computer PROGRAM ALARM will be lighted. Disregard and press ERROR RESET button on LEB DESK.

6.2.16.5 Inner Gimbal Response Test

6.2.16.5.1 Enter the code 2 010 000 000 in C-START Module 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2107 IGA SERVO ERROR on 4A1-A3-CH1.

6.2.16.5.2 Insert the following sequence into K148:

a. VERB 41, NOUN 20, ENTER

b. +00000 ENTER

c. +00000 ENTER

d. +00000 ENTER

Wait 60 seconds

6.2.16.5.3 Insert VERB 36 into K148. Press ENTER pushbutton.

6.2.16.5.4 Enter 1000 into 4A2-A6-R155. The top part of switch should be lighted. Ensure that no other function switches on 4A2-A6-R155 are lighted.

6.2.16.5.5 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a 2 ± 0.2 VDC step into the IG Stabilization Loop.

NOTE: If the transient cause by the step input does not die out within 5 seconds, remove IMU OPERATE power by opening the IMU MW A & MW B circuit breaker on the right hand circuit breaker panel.

6.2.16.5.6 Start Analog Recorder 4A1-A3 using a chart speed of 20 MM/SEC.

6.2.16.5.7 Enter 0000 into 4A2-A6-R155; the top part of switch should be out. Ensure that no other function switches on 4A2-A6-R155 are lighted. Press XEQ/SEAL pushbutton to remove the step input to the IG Stabilization Loop. The bottom part of switch shall go out.

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6.2.16.5.8 After transient has died out, stop Analog Recorder. Record the loop response time by measuring the time interval between removing the step (initial disturbance) and the peak of the first overshoot. In addition, record the total number of overshoots.

6.2.16.5.8.1 The Inner Gimbal stabilization loop response time shall be less than 0.8 seconds.

6.2.16.5.8.2 The maximum number of overshoots on the torque motor input signals shall be two.

6.2.16.6 Middle Gimbal Response Test

6.2.16.6.1 Enter the code 2 021 000 000 into C-START MODULE 4A1-A5-0156. Press the XEQ/SEAL pushbutton to call up CG 2137 MCA SERVO ERROR on 4A1-A3-CH1.

6.2.16.6.2 Insert the following sequence into K148

a. VERB 41, NOUN 20 ENTER

b. +00000 ENTER

c. +00000 ENTER

d. +00000 ENTER

Wait 60 seconds

6.2.16.6.3 Insert VERB 36 into K148. Press ENTER pushbutton.

6.2.16.6.4 Enter 0100 into 4A2-A6-R155 to enter a 2.0 ± 0.2 VDC step into the MG Stabilization Loop.

NOTE: If the transient caused by the step input does not die out within 5 seconds, remove IMU OPERATE power by opening the IMU MNA & MNB circuit breaker on the Right Hand Circuit Breaker panel.

6.2.16.6.6 Start Analog Recorder 4A1-A3 using a chart speed of 20 MM/SEC.

6.2.16.6.7 Enter 0000 into 4A2-A6-R155. The top part of switch shall go out. Ensure that no other function switches on 4A2-A6-R155 are lighted. Press the XEQ/SEAL pushbutton to remove the step input to the MG Stabilization Loop.

6.2.16.6.8 After transients have died out, stop Analog Recorder. Record the loop response time by measuring the time interval between removing the step (initial disturbance) and the peak of the first overshoot. In addition, record the total number of overshoots.

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6.2.16.6.8.1 The Middle Gimbal stabilization loop response time shall be less than 0.8 seconds.

6.2.16.6.8.2 The maximum number of overshoots on the torque motor input signals shall be two.

6.2.16.7 Outer Gimbal Response Test

6.2.16.7.1 Enter the code 2 025 000 000 C-START Module 4A1-A5-C156. Press XEQ/SEAL pushbutton to call up CG 2167 OGA SERVO ERROR On 4A1-A3-CH1.

6.2.16.7.2 Insert the following sequence into K148.

a. VERB 41, NOUN 20, ENTER

b. +00000 ENTER

c. +00000 ENTER

d. +00000 ENTER

Wait 60 seconds

6.2.16.7.3 Insert VERB 36 into K148. Press ENTER pushbutton.

6.2.16.7.4 Enter 0010 into 4A2-A6-R155. The top half of switch should be lighted. Ensure that no other function switches on 4A2-A6-R155 are lighted.

6.2.16.7.5 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a 2.0 + 0.2 VDC step into the OG Stabilization Loops.

NOTE: If the transient caused by the step input does not die out within 5 seconds, remove IMU OPERATE power by opening the IMU MNA & MNB circuit breaker on the Right Hand Circuit Breaker Panel.

6.2.16.7.6 Start Analog Recorder 4A1-A3 using a chart speed of 20 MM/SEC.

6.2.16.7.7 Enter 0000 into 4A2-A6-R155. The top half of switch shall go out. Ensure that no other function switches on 4A2-A6-R155 are lighted. Press the XEQ/SEAL pushbutton to remove the stop input to the OG Stabilization Loop.

6.2.16.7.8 After transients have died out, stop Analog Recorder. Record the loop response time by measuring the time interval between removing the step (initial disturbance) and the peak of the first overshoot. In addition, record the total number of overshoots.

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6.2.16.7.8.1 The Outer Gimbal stabilization loop response time shall be less than 0.8 seconds.

6.2.16.7.8.2 The maximum number of overshoots on the OGA SERVO ERROR signals shall be two.

6.2.16.8 Insert the following sequence into K148

- a. VERB 41, NOUN 20 ENTER
- b. +00000 ENTER
- c. +00000 ENTER
- e. +00000 ENTER

6.2.17 IRIG Scale Factor Test

6.2.17.1 Proceed with this test if 6.2.4 Operate Power On Test or 6.2.2.2 Turn On Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2 before proceeding.

6.2.17.2 Set up Analog Recorders 4A3-A2 and 4A1-A2 to monitor the following signals:

Analog Recorder

- a. CG 2110 IG TM INPUT 4A3-A2
- b. CG 2140 MG TM INPUT 4A3-A2
- c. CG 2170 OG TM INPUT 4A3-A2
- d. CG 2117 IG SERVO ERROR 4A1-A2
- e. CG 2147 MG SERVO ERROR 4A1-A2
- f. CG 2177 OG SERVO ERROR 4A1-A2

6.2.17.3 Start Analog Recorder chart drive using a speed of 1 MM/Second. Recorder shall run for duration of this test.

6.2.17.4 Insert and verify the following sequence into K148.

- VERB 57 ENTER
- 00005 ENTER

Observe 07 in MAJOR MODE

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6.2.17.5 VERB 21, NOUN 30 shall flash on CRT requesting a load of the test numbers. Select the desired Test Number from Table XVIII. Enter the appropriate + 0000X into K148. Press the ENTER push-button.

Table XVIII. Test Numbers and Positions for IRIG Tests

Test Number	Gyro being tested and direction of torque
+00001	+X
-00001	-X
+00002	+Y
-00002	-Y
+00003	+Z
-00003	-Z

NOTE: If all gyros are being tested, the test must be repeated once for each Test Number in the above table. If only one gyro is being tested, the test need only be repeated for the two applicable Test Numbers.

6.2.17.6 During the following operation, disregard the CDU FALL lamp indication unless specified:

The G&N System will automatically cycle through ZERO ENCODE, FINE ALIGN, ATT CONT, FINE ALIGN, COARS ALIGN and FINE ALIGN Modes. When alignment is completed for the specific IRIG under test, it will be torqued through approximately 360 degrees. There are six cycles of approximately 20 minutes each, which correspond to both plus and minus configurations of the X, Y, and Z IRIG's. The approach time period for one cycle test completion can be observed by performing the following sequences:

- Insert VERB 11, NOUN 01 into K148. Press ENTER pushbutton.
- Insert 01650 into K148. Press ENTER pushbutton.
- Verify on CRT that R1 is counting down octally. When R1 has counted to zero, VERB 07 and NOUN 30 will be flashing. This indicates completion of one of the six cycle IRIG test.

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6.2.17.7 Record the value displayed in register R1 CRT for the appropriate Test Number in Table XIX.

Table XIX. Display of Test Parameters

Test Number	Symbol	Display in R1
+00001	ΔE_{-X}	$\pm X X X X X$
-00001	ΔE_{+X}	$\pm X X X X X$
+00002	ΔE_{-Y}	$\pm X X X X X$
-00002	ΔE_{+Y}	$\pm X X X X X$
+00003	ΔE_{-Z}	$\pm X X X X X$
-00003	ΔE_{+Z}	$\pm X X X X X$

6.2.17.8 Enter VERB 36 into K148. Press the ENTER pushbutton. Press The ERROR RESET switch on the LEB AGC DSKY.

6.2.17.9 Repeat 6.2.17.4 through 6.2.17.11 until all Test number in Table XVIII have been utilized.

6.2.17.10 After all completion of all test numbers, stop the Analog Recorder.

6.2.17.10.1 Enter VERB 40, NOUN 20 into K148. Press ENTER pushbutton. Wait 90 seconds.

6.2.17.10.2 Enter VERB 41, NOUN 20 into K148. Press ENTER pushbutton.

6.2.17.10.3 Enter +00000 into K148, three times, press ENTER pushbutton after each entry.

6.2.17.11 Perform the following calculations:

a. X IRIG Scale Factor Error

$$X_E = \frac{\Delta E_{+X} + \Delta E_{-X}}{2} \quad \text{parts/million}$$

b. Y IRIG Scale Factor Error

$$Y_E = \frac{\Delta E_{+Y} + \Delta E_{-Y}}{2} \quad \text{parts/Million}$$

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6.2.17.12 e. Z IRIG Scale Factor Error

$$Z_E = \frac{\Delta E_{+Z} + \Delta E_{-Z}}{2} \quad \text{_____ parts/million}$$

6.2.17.12.1 The Scale Factor error deviation for each IRIG shall be less than + 1750 parts/million.

6.2.18 PIPA Scale Factor Determination Test

6.2.18.1 Proceed with this test if 6.2.2 Operate Power On Test or 6.2.2.2 Turn On Procedure has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2 Turn on Procedure before proceeding with this test.

6.2.18.2 Verify the IMU OPERATE power has been applied and that the IMU TEMP MODE switch has been in the AUTO OVERRIDE or PROPORTIONAL for a minimum of one hour.

6.2.18.3 Verify that the TRANSFER switch is set to COMPUTER position.

6.2.18.4 Test Initiation

6.2.18.4.1 Insert and verify the following sequence into K-148

6.2.18.4.1 a. VERB 57 ENTER

b. 00002 ENTER

Observe 07 in MAJOR MODE.

6.2.18.4.2 Observe VERB 06, MOUN 61 flashing. Rows R1 and R2 contain the NB azimuth and latitude respectively in degrees. If R1 and R2 agree with known azimuth and latitude insert VERB 33, ENTER into K148 and proceed to 6.2.18.4.4.

6.2.18.4.3 Insert and verify the following sequence into K148.

a. VERB 21 ENTER

b. +X X X X X (Correct NB azimuth) ENTER

c. VERB 22 ENTER

d. +28523 (Correct NB latitude) ENTER

e. VERB 33 ENTER

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Table XXI

Position No. as Displayed in R3	PIPA Being Tested and its Orientation
00001	X PIPA Up
00002	X PIPA Down
00003	Z PIPA Up
00004	Z PIPA Down
00005	Y PIPA Up
00006	Y PIPA Down

- 6.2.18.4.8 If it is desired to perform the test in the next position, enter VERB 33 into K148. Press the ENTER pushbutton and return to 6.2.18.4. After completion of position 6, the test shall be terminated by entering VERB 34 into K148. Press the ENTER pushbutton.
- 6.2.18.4.9 Enter VERB 40, NOUN 20 into K148. Press the ENTER pushbutton.
- 6.2.18.4.10 Enter VERB 41, NOUN 20 into K148. Press the ENTER pushbutton.
- 6.2.18.4.11 Enter +00000 into K148. Press the ENTER pushbutton.
- 6.2.18.4.12 Enter +00000 into K148. Press the ENTER pushbutton.
- 6.2.18.4.13 Enter +00000 into K148. Press the ENTER pushbutton. The COARS ALIGN mode lamp shall light.
- 6.2.18.5 Calculations

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6.2.18.5.3.1 These values shall fall within 400 PPM of the nominal SF of 5.85 cm/sec/pulse.

6.2.18.5.4 Compute the PIPA biases using the values computed in 6.2.18.5.1 and 6.2.18.5.2 as follows:

$$b_x = \frac{(A_1 + A_2)}{2} = \underline{\hspace{2cm}}$$

$$b_z = \frac{(A_3 + A_4)}{2} = \underline{\hspace{2cm}}$$

$$b_y = \frac{(A_5 + A_6)}{2} = \underline{\hspace{2cm}}$$

6.2.18.5.4.1 These values shall fall within $0.0 \pm 0.50 \text{ cm/sec}^2$.

Table XXII. Local Gravity Requirements	
Location	Local Gravity (cm/sec ²)
KSC	979.24

6.2.18.6 Specification MA 0201-3179 Table III shall be utilized for calculations.

6.2.18.7 Verify PIPA Scale Factor Determination Test passed & failed.

6.2.19. IRIG Coefficient Determination Test

6.2.19.1 Proceed with this test if 6.2.4 Operate Power On Test or 6.2.2.2 Turn On Procedure has been performed, and system operation has not been interrupted. If system operation has been interrupted, perform Turn On Procedure of 6.2.2.2 before Proceeding with this test.

6.2.19.2 Verify or set transfer switch to COMPUTER.

6.2.19.3 Obtain, verify and record the azimuth orientation of Spacecraft Z Axis.

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6.2.18.4.4 Observe VERB 06 NOUN 66 flashing. Rows R1, R2 and R3 shall indicate:

R1 + 00032 (NB Tilt angle)
R2 - 00000 (Test Index)
R3 + 0000X (Test Position)

Where X indicates positions 1 through 6

NOTE: To complete this test, positions 1 through 6 shall be performed.

If R1, R2 and R3 agree with the above, insert VERB 33, ENTER into K148 and proceed to 6.2.18.4.6

6.2.18.4.5 Insert and verify the following sequence into K148.

a. VERB 21, NOUN 02 ENTER
b. 01311 ENTER
c. +00032 (Correct NB tilt) ENTER
d. VERB 21, NOUN 01 ENTER
e. 01311 ENTER
f. -00000 (Correct index) ENTER
g. VERB 21 NOUN 02 ENTER
h. 01303 ENTER
i. +0000X (position) ENTER
j. VERB 33 ENTER

6.2.18.4.6 After approximately 5 minutes record CRT indications of OG, IG and MG CDU angles.

6.2.18.4.7 After approximately 18 minutes, VERB 06 NOUN 66 will appear flashing Record R1 (XXXXX), R2 (.XXXXX) and R3 (position number).

Table III

Revision No. as Discrepancy in MS

DATA Being Checked and
for Confirmation

0001

1. 111.10

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6.2.18.5.1 The values obtained from R1 and R2 for each position are combined as follows:

Contents of (R1)₁

A₁ = +XXXXX

Where 1 = Position Number

A₁ = -----

A₂ = -----

A₃ = -----

A₄ = -----

A₅ = -----

A₆ = -----

Contents of (R2)₁

XXXXX

6.2.18.5.2 Compute the average G for each PIPA using A₁ from step 1:

a. for X - PIPA G_x = $\frac{A_1 - A_2}{2}$ =

b. for Z - PIPA G_z = $\frac{A_3 - A_4}{2}$ =

c. for Y - PIPA G_y = $\frac{A_5 - A_6}{2}$ =

6.2.18.5.3 Compute the PIPA scale factors using five significant figures from 6.2.18.5.2 and the value of local gravity obtained from Table XXII.

h_x = $\frac{5.85 \text{ (local g)}}{G_x}$ =

h_z = $\frac{5.85 \text{ (local g)}}{G_z}$ =

h_y = $\frac{5.85 \text{ (local g)}}{G_y}$ =

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6.2.19.4 Insert and verify the following sequence into K148.

- a. VERB 57 ENTER
- b. Observe VERB 21, NOUN 01 Flashing
- c. 00001 ENTER
- d. Observe 07 in MAJOR MODE

6.2.19.5 Observe VERB 06, NOUN 61 flashing. Rows R1 and R2 shall contain the nav base azimuth and test site latitude respectively. If the azimuth and latitude indications are in agreement with the known values for these parameters press VERB 33, ENTER on K148 and proceed to 6.2.18.7.

6.2.19.6 Insert and verify the following sequence into K148.

- a. VERB 21 ENTER
- b. X X X . X X (correct NB azimuth) ENTER
- c. VERB 22 ENTER
- d. X X X . X X (correct site latitude) ENTER
- e. VERB 33 ENTER

6.2.19.7 Observe VERB 06, NOUN 66 flashing with Rows R1, R2, and R3 indicating:

R1 +00032
R2 +00000
R3 +00001

If the above indications are present on the CRT or DSKY insert VERB 33, ENTER into K148 and proceed to 6.2.19.9.

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6.2.19.8 Insert and verify the following sequence into K148.

- a. VERB 21 NOUN 02 ENTER
- b. 01231 ENTER
- c. +00032 ENTER
- d. VERB 21 NOUN 02 ENTER
- e. 01232 ENTER
- f. +00000 ENTER
- g. VERB 21 NOUN 02 ENTER
- h. 01223 ENTER
- i. +00001 ENTER
- j. VERB 33 ENTER

6.2.19.9 The G&N system will now cycle through the following modes as indicated on the IMU CONTROL Panel.

- a. ZERO ENCODER
- b. FINE ALIGN
- c. ATT CONT
- d. FINE ALIGN
- e. COARS ALIGN
- f. FINE ALIGN

6.2.19.10 After approximately 5 minutes record CRT indication of IG, MG and OG CDU's.

6.2.19.11 After approximately 14 minutes, VERB 06, NOUN 66 will appear flashing. Record indication of R1 and R2.

NOTE: R1 should be + 00000.

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6.2.19.12 To repeat test for positions 2 through 6 insert VERB 33 ENTER twice into K148 after performing 6.2.18.11 for each position except after position 6.

6.2.19.13 Insert and verify the following sequence into K148:

a. VERB 33	ENTER
b. Observe VERB 06, NOUN 66	flashing
c. VERB 21 NOUN 02	ENTER
d. 01231	ENTER
e. +00032	ENTER
f. VERB 21 NOUN 02	ENTER
g. 01232	ENTER
h. +00001	ENTER
j. VERB 21 NOUN 02	ENTER
k. 01223	ENTER
l. +00001	ENTER
m. VERB 33	ENTER

NOTE: Approximately 90 seconds after the final entry into the FINE ALIGN mode (f below) perform 6.2.19.15.

6.2.19.14 The O&N System will now cycle through the following mode as indicated on the IMU CONTROL panel.

a. ZERO ENCODER
b. FINE ALIGN
c. ATT CONT
d. FINE ALIGN
e. COARS ALIGN
f. FINE ALIGN

6.2.19.15 Insert and verify the following sequence into K148:

a. VERB 06 NOUN 20 ENTER

6.2.19.16 Record the indications of LEB DSKY rows R1, R2 and R3.

6.2.19.17 After approximately 14 minutes, VERB 06, NOUN 66 will appear flashing. Record indication of R1 and R2.

6.2.19.18 Repeat the test for positions 2 through 6 by inserting VERB 33 ENTER into K148 after 6.2.19.17 and then performing 6.2.19.13.m through 6.2.19.17.

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6.2.20 Fine Alignment Test

6.2.20.1 Proceed with this test if 6.2.4 Operate Power On Test has been completed and system operation hasnot been interrupted. If system operation has been interrupted, perform 6.2.2.2 Turn On Procedure.

6.2.20.2 Prior to performing this test, the G&N Installation Qualification Fixture shall be installed on the supporting fixture and adjusted to permit proper operation of the G&N optics. The azimuth supplied by the azimuth autoset (Ref. No. 1) shall be known to ± 30 minutes of arc.

NOTE: G&N System shall have had OPERATE power applied for a minimum of one hour. System shall be in COARSE ALIGN mode under computer control with gimbal angles at zero.

6.2.20.3 Set OPTICS mode switch to ZERO OPTICS. After ZERO ENCODER lamp has extinguished onCondition Annunciator panel, return OPTICS mode switch to MANUAL.

6.2.20.4 Initiate the test by inserting the following into K148:

- a. VERB 57 ENTER
- b. Observe VERB 21, NOUN 01 flashing
- c. 00003 ENTER
- d. Observe PROGRAM lights, 07

6.2.20.5 Observe that the ZERO ENCODER lamps on Condition Annunciator and IMJ CONTROL panel light and then extinguish.

6.2.20.6 Observe VERB 06, NOUN 61 flashing with the following display:

- a. R1 + xxx.xx (45.000, + S/C AZ degrees)
- b. R2 + 00000 (TOT 1 EL, degrees)
- c. R3 00001 (TOT number)

If R1 and R2 are correct for present location insert VERB 33, ENTER into K148 and proceed to 6.2.20.9.

6.2.20.7 To correct R1, insert and verify the following into K148:

- a. VERB 21 ENTER
- b. + xxx.xx (45.000 + S/C AZ) ENTER

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6.2.20.8 To correct R2, insert and verify the following into K148:

- a. VERB 22 ENTER
- b. + 00000 ENTER
- c. VERB 33 ENTER

6.2.20.9 Observe VERB 06, HOUN 61 flashing with the following display:

- a. R1 - xxx.xx (-45.000 + S/C AZ degrees)
- b. R2 + 00000 (TOT 2 EL, degrees)
- c. R3 00002 (TOT number)

6.2.20.10 If R1 and R2 are correct for present location insert VERB 33, ENTER into K148 and proceed to 6.2.20.12.

6.2.20.10 To correct R1, insert and verify the following into K148:

- a. VERB 21 ENTER
- b. + xxx.xx (-45.000 + S/C AZ) ENTER

6.2.20.11 To correct R2, insert and verify the following into K148:

- a. VERB 22 ENTER
- b. + 00000 ENTER
- c. VERB 33 ENTER

6.2.20.12 Observe VERB 06, HOUN 61 flashing with the following display.

- a. R1 + 13500 (SM A2)
- b) R2 + 28516 (LAT)

If R1 and R2 are correct for present location, insert VERB 33, ENTER into K148 and proceed to 6.2.20.15.

6.2.20.13 To correct R1 insert and verify the following into K148:

- a. VERB 21 ENTER
- b. + 13500 (correct SM A2) ENTER

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- 6.2.20.23 Observe VERB 21, NOUN 30 flashing, insert and verify 00002, ENTER into K148.
- 6.2.20.24 Repeat 6.2.20.16 through 6.2.20.19.
- 6.2.20.25 Approximately 7 minutes after the IMU enters the FINE ALIGN mode, VERB 06, NOUN 66 will flash. R1 (whole) and R2 (fractional) will contain the misalignment (arc sec) of the X PIPA IA about the Z_{SM} . Record and insert VERB 33, ENTER. R1 (whole) and R2 (fractional) will contain the misalignment (arc sec) of the Y PIPA IA about X_{SM} . Record R1 and R2.
- 6.2.20.26 Insert and verify VERB 34, ENTER into K148.
- 6.2.20.27 Repeat 6.2.20.4 through 6.2.20.14.
- 6.2.20.28 Observe VERB 21, NOUN 30 flashing, insert and verify 00003, ENTER into K148.
- 6.2.20.29 Repeat 6.2.20.16 through 6.2.20.19.
- 6.2.20.30 Approximately 7 minutes after the IMU enters the FINE ALIGN mode, VERB 06, NOUN 66 will flash. R1 (whole) and R2 (fractional) will contain the misalignment (arc sec) of the X PIPA IA about Z_{SM} . Record and insert VERB 33, ENTER. R1 (whole) and R2 (fractional) will contain the misalignment (arc sec) of the Z PIPA IA about the X_{SM} . Record R1 and R2.
- 6.2.20.31 Insert and verify the following into K148:
- a. VERB 34 ENTER
 - b. VERB 41 NOUN 20 ENTER
 - c. + 00000 ENTER
 - d. + 00000 ENTER
 - e. + 00000 ENTER
- 6.2.20.32 The misalignment angle of an IA about any SM axis shall be 150 arc seconds or less.

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6.2.21 Gyrocompassing Test

6.2.21.1 Proceed with this test if the Operate Power On Test 6.2.4 or the Turn On Procedure of 6.2.2.2 has been completed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.2.2 before proceeding.

6.2.21.2 Load the Gyrocompassing Data Load Tape (FO4C014KD0033-00) on the tape reader. This tape loads nominal IRIG and PIPA parameters for G&N 121 and also loads gyrocompassing azimuth, latitude and Nav. Base azimuth for testing in the M30B. After display and verification of the data load, the tape will initiate the Prelaunch Alignment Program.

6.2.21.3 Start tape reader.

6.2.21.4 After the tape reader stops, the data load may be changed by performing the following sequences.

6.2.21.4.1 If required to change the IRIG or PIPA data load:

- a. Convert the data from engineering units to the AGC octal as stored in erasable memory.
- b. Load the octal data into the AGC by inserting the following sequence into K148.

VERB	21	NOUN	02	ENTER
YYYYY	ENTER	(E-Memory address)		
XXXXX	ENTER	(OCTAL data)		

6.2.21.4.2 If required to change the gyrocompassing azimuth data load:

- a. Perform the following calculation:

$$\frac{\text{Gyrocompassing Azimuth}}{360} \times 16384 = \text{AAAA.BBBBB}$$

- b. Load correction into AGC by inserting the following sequence into K148:

VERB 21	NOUN 02	ENTER	
01504	ENTER		
SOAAAA	ENTER		(S = sign)
VERB 21	NOUN 01	ENTER	
01505	ENTER		
SBBBBB	ENTER		

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6.2.21.4.3 If required to change the nav. base azimuth data load:

- a. Perform the following calculation:

$$\frac{\text{Nav. Base Azimuth}}{360} \times 16384 = \text{EEEE.FFFFF}$$

- b. Load correction into AGC by inserting the following sequence into KI48:

VERB 21	MOUW 02	ENTER
01612	ENTER	
SOREEE	ENTER	(S - sign)
VERB 21	MOUW 01	(ENTER)
01613	ENTER	
SFFFFF	ENTER	

6.2.21.4.4 If required to change the latitude data load:

- a. Perform the following calculation:

$$\frac{\text{Latitude}}{360} \times 16384 = \text{MMMM.NNNNN}$$

- b. Load correction into AGC by inserting the following sequence into KI48:

VERB 21	MOUW 02	ENTER
01502	ENTER	
SOMMMM	ENTER	
VERB 21	MOUW 01	ENTER
01503	ENTER	
SNNNNN	ENTER	

6.2.21.5 Start the tape reader.

- 6.2.21.5.1 When the tape reader stops, observe VERB 06, MOUW 61 flashing with R1 displaying gyrocompassing azimuth +77.99 degrees within ± 0.01 degrees.

6.2.21.6 Start the tape reader.

- 6.2.21.6.1 When the tape reader stops, observe VERB 06, MOUW 61 flashing with R1 displaying Nav. Base azimuth, +165.00 within 0.01 degrees and R2 displaying local latitude, +28.516 within 0.006 degrees.

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- 6.2.21.7 Start the tape reader to initiate the Initialization and Inertial Reference portions of the Prelaunch alignment Program. Major Mode will indicate 01.
- 6.2.21.8 Within 10 minutes the MAJOR MODE lights will indicate 02 on the CRT and DSKY when the program enters the gyrocompass portion of the PRE-LAUNCH ALIGNMENT program. At this time, and during each succeeding 15 minute interval for the duration of the test, record in Table 6.1 the dial readings for the Outer Gimbal, Inner Gimbal and Middle Gimbal CDU's. After recording the first (t=0) set of data immediately proceed to step 6.2.21.9.
- 6.2.21.9 Set the CONTROLLER MODE switch to DIRECT, OPTICS MODE switch to ZERO OPTICS, and CONTROLLER SPEED switch to MED on the G&N Indicator Control Panel.
- 6.2.21.10 After the ZERO ENCODER lamp on Event Module 4A3-A4-E1-7 extinguishes set the Optics Mode switch to MANUAL.
- 6.2.21.11 Enter the following inputs into K148:
- VERB 37, ENTER
03, ENTER
- NOTE: The 03 will appear in the MOUN lights when entered. Following the pressing of the ENTER pushbutton, the MOUN lights will be blanked. When the test is entered, 03 will appear in the MAJOR MODE lights within 10 seconds and the KEY RELEASE lamp on the DSKY will illuminate.
- 6.2.21.12 Observe that the Major Mode lights indicate 03 on the CRT.
- 6.2.21.13 Press the KEY RELEASE Pushbutton on the LEB DSKY.
- 6.2.21.14 Perform paragraphs 6.2.20.6 through 6.2.20.11 of the G&N FINE ALIGNMENT TEST, to enter the correct components for TARGETS 1 and 2.
- 6.2.21.15 Observe that the "MARK" command, VERB 51 is flashing on the CRT and DSKY and that the following values are displayed in R1, R2 and R3.

R1	+ 00001	(Target #1)
R2	+ 00002	(Target #2)
R3	+ 00000	

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- 6.2.21.16 Align the SXT StLOS with the reticle dot on Target #1. When aligned, press the MARK pushbutton.
- 6.2.21.16.1 If not satisfied with the MARK, enter VERB 52 into K148 or LEB DSKY. Press ENTER pushbutton and repeat step 6.2.21.16. If satisfied with the "MARK" proceed to 6.2.21.17. Observe that VERB 51 continues to flash on CRT and DSKY.
- 6.2.21.17 Align the SXT StLOS with the reticle dot on Target #2. When aligned, press the MARK pushbutton. Observe 50 in the VERB lights on the CRT and DSKY requesting operator action.
- 6.2.21.17.1 If not satisfied with this "MARK" reject it by entering VERB 52 into K148 or LEB DSKY. Press ENTER pushbutton and repeat step 6.2.21.17. If satisfied with the "MARK", press the ENTER pushbutton and proceed to 6.2.21.18.
- 6.2.21.18 Observe the following displays on the CRT and LEB DSKY: (R1, R2 and R3 contain the three misalignment angles).
- VERB 06, MOUN 67 (FLASHING)
- R1 + XX.XXX (X Gyro Torquing Angle)
- R2 + XX.XXX (Y Gyro Torquing Angle)
- R3 + XX.XXX (Z Gyro Torquing Angle)
- 6.2.21.19 Enter the following into K148:
- VERB 21 ENTER 00000 X set torq / to 0
- VERB 22 ENTER 00000 Y set torq / to 0
- VERB 33 ENTER
- 6.2.21.20 Observe and verify that the MAJOR MODE lights indicate 02 on the CRT and DSKY.
- 6.2.21.20.1 Wait two (2) hours before proceeding.
- 6.2.21.21 Repeat steps 6.2.21.9 through 6.2.21.18. Record the readings for the appropriate gyros in Table 6.2. (First Reading, Data Set #2).
- 6.2.21.21.1 Enter the following inputs into K148:
- VERB 34 ENTER

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6.2.21.22 Repeat steps 6.2.21.9 and 6.2.21.18 two (2) more times to obtain the second and third readings. Each time that 6.2.21.18 is completed, record the readings for the appropriate gyros in Table 6.2, and enter the following into K148:

VERB 34 ENTER

6.2.21.22.1 Calculate the average value of the three readings for each gyro and record in Table 6.2.

6.2.21.23 At 30 minute intervals perform steps 6.2.21.23.1 through 6.2.21.23.3 three times to obtain data sets 3 and 4.

6.2.21.23.1 Repeat steps 6.2.21.9 through 6.2.21.18.

6.2.21.23.2 Record the contents of R1, R2 and R3 for the appropriate gyros in Table 6.2.

6.2.21.23.3 Enter the following into K148:

VERB 34 ENTER

6.2.21.24 Calculate the average value of the three readings for each gyro in each data set. Record in Table 6.2.

6.2.21.24.1 The average values recorded in Table 6.2, data sets 2, 3 and 4 shall be:

+ 0.05 degrees or less on X
+ 0.05 degrees or less on Y
+ 0.60 degrees or less on Z

6.2.21.24.2 The average values for data sets 3 and 4 shall not deviate from the average value for data set 2 by more than the following amounts:

+ 0.02 degrees or less than X
+ 0.02 degrees or less than Y
+ 0.08 degrees or less than Z

NOTE: Coordinate the next steps with the test conductor before proceeding.

6.2.21.25 After recording data set 4, have the input voltage to the G&M system adjusted to 26.1 volts dc for a period of one hour.

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6.2.21.25.1 The following lamps on Event Module 4A3A5E1 shall be lighted:

SIGNAL

- a. 28 V DC AGC
- b. 28 V DC OPERATE/IMU
- c. 28V DC OPTICS

6.2.21.25.2 Record voltage readings on the CRT of the following signals on the data sheet:

Measurement

List No.

Signal

Requirement

a. CG 1400	IMU 2.5 V 25.6 MC Supply	2.1 to 2.9 VRMS
b. CG 1401	OPT 2.5 V 25.6 MC Supply	2.1 to 2.9 VRMS
c. CG 1301	IMU 2 V 3200 CPS Supply	2.9 to 4.10 VRMS
d. CG 1101	-28 VDC ELECTRONIC	-33.7 to -21.3 VDC
e. CG 1030	+3 VDC AGC Supply	+1.88 to 4.12 VDC
f. CG 1020	+13 VDC AGC Supply	+11.7 to +14.3 VDC
g. CG 1201	IMU 28 V 800 CPS 1% 0°	27.0 to 29.9 VRMS
h. CG 1203	IMU 28 V 800 CPS 5% 0°	24.7 to 30.3 VRMS
i. CG 1202	IMU 28 V 800 CPS 5% -90°	26.1 to 29.9 VRMS
j. CG 1204	CDU 28 V 800 CPS 5% -90°	26.1 to 29.9 VRMS
k. CG 1211	OPT 28 V 800 CPS 1% 0°	27 to 29 VRMS
l. CG 1212	OPT 28 V 800 CPS 5% -90°	26.1 to 29.9 VRMS

6.2.21.25.3 Repeat steps 6.2.21.23.1 through 6.2.21.23.3 three times thirty minutes after adjustment of the G&N input voltage to 26.1 volts dc.

6.2.21.25.4 Repeat steps 6.2.21.23.1 through 6.2.21.23.3 three times one hour after adjustment of the G&N input voltage to 26.1 volts dc. Record the data as data set 6 in Table 6.2 and calculate and record the average values.

6.2.21.26 Have the input voltage to the G&N system adjusted to 31.3 volts dc for a period of one hour.

6.2.21.26.1 The following lamps on Event Module 4A3A5E1 shall be lighted:

SIGNAL

- a. 28 V DC AGC
- b. 28 V DC OPERATE IMU
- c. 28 V DC OPTICS

6.2.21.26.2 Record the voltage readings for the signals listed in 6.2.21.25.2. The requirements shall be those listed in 6.2.21.25.2.

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6.2.21.26.3 Repeat steps 6.2.21.23.1 through 6.2.21.23.3 three times thirty minutes after adjustment of the G&N input voltage to 31.3 volts dc. Record the data as data set 7 in Table 6.2 and record the average values.

6.2.21.26.4 Repeat steps 6.2.21.23.1 through 6.2.21.23.3 three times one hour after adjustment of the G&N input voltage to 31.3 volts dc. Record the data as data set 8 in Table 6.2 and calculate and record the average values.

6.2.21.27 Have the input voltage to the G&N system adjusted to 28 volts dc.

6.2.21.28 Enter the following into the K148:

```

VERB 37      ENTER
00           ENTER
VERB 40      MOUN 20    ENTER wait 90 seconds
VERB 41      MOUN 20    ENTER
+00000      ENTER
+00000      ENTER
+00000      ENTER

```

6.2.21.29 Verify that COARSE ALIGN is the only mode lamp lighted on the IMU Control Panel.

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TABLE 6.1

Time Minutes	CDU Dial Readings		
	00	10 10	00
0			
15			
30			
45			
60			
75			
90			
105			
120			
135			
150			
165			
180			
195			
210			
225			
240			
255			
270			
285			
300			

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TABLE 6.2

Data Set	X Gyro Torquing Angle (R1)	Y Gyro Torquing Angle (R2)	Z Gyro Torquing Angle (R3)
	First Reading	First Reading	First Reading
	Second Reading	Second Reading	Second Reading
	Third Reading	Third Reading	Third Reading
	Average	Average	Average
1			
2 (2 hours)			
3 (2.5 hours)			
4 (3.0 hours)			
5 (Lo Bus)			
6 (Lo Bus)			
7 (Hi Bus)			
8 (Hi Bus)			

APOLLO G&N Specification
ND 1002325 A

Original Issue Date:
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Class A Release

PCSI INSTALLATION CHECKOUT PROCESS
SPECIFICATION FOR THE APOLLO GUIDANCE
AND NAVIGATION SYSTEM -- BLOCK II

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
11/1/66	A	31765	1-116 was 116 pages, now 118 pages.	EA	WLS

This specification consists of page 1 to 118 including Appendix I pages 116, 117 and Addendum I, page 118

APPROVALS

NOT REQUIRED
PER
C/A 497-0274
NASA/MSC

ACED

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1. INTRODUCTION
 - 1.1 The individual Spacecraft (SC) installed Guidance and Navigation (G&N) System to be checked out per this process specification shall consist of one of each of the following major assemblies: The applicable part numbers shall be determined by drawing No. 2014999.
 - 1 - Optical Unit Assembly
 - 1 - Navigation Base Assembly, Block II
 - 1 - Inertial Measurement Unit (IMU) & PIPA Elect. Assy.
 - 1 - Power and Servo Assembly (PSA)
 - 1 - Apollo Guidance Computer Group
 - 1 - G&N Interconnect Harness Assembly
 - 1 - Signal Conditioner Assembly
 - 1 - Display and Control Group (D & C)
 - 1 - Coupling Data Unit
 - 1.2 The G&N System herein shall be identified as a Block II system. The computer contains the SUNDIAL C or D program test ropes in the core rope memory.
2. SCOPE
 - 2.1 This specification outlines the checkout requirements for the G&N System installed in the Apollo Command Module Spacecrafts.
 - 2.2 This document is to be used as technical support for all Block II G&N System test documentation for Command Module spacecraft testing. This document shall be amended by addendum to support applicable hardware, mission, or program differences.

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3. APPLICABLE DOCUMENT

3.1 Documents Required by This Specification

3.1.1 When the requirements of this specification conflict with the drawing requirements, the drawing requirements shall have precedence.

PS 2015000	Master End Item Specification, Part II, Product Configuration and Acceptance Test Requirements, G&N Spacecraft Equipment Command Module, Block II
ICD MH01-01307-216	CDU to TVC Servo Amps Electrical Block II
ICD MH01-01324-216	Attitude Error Signals Electrical Block II
ICD MH01-01325-216	Total Attitude Signals
ICD MH01-01327-216	G&N Electrical Input Power
ICD MH01-01328-216	G&N Data Transmission to Operational and Flight Qual. Telemetry
ICD MH01-01342-216	G&N System Caution and Warning System Interface
ICD MH01-01349-416	G&N Thermal Requirements for Block II AGE
ICD MH01-01344-216	Mode Control Signals S/C to ISS Discretes
ICD MH01-01335-200	Electrical Inertial Temperature Controller
ICD MH01-01380-216	Command Module Guidance Computer Electrical Interfaces Block II
ICD MH01-01386-216	Attitude Error to SIVB
MH01-01390-200	G&N PSA Adapter Module ACE-S/C DTMS and DTCS Block II Vehicles.
MA0201-5108	ACE-S/C Computer Subprogram Program Requirements 2TV1, NAA
MA0308-0107	Mechanical Installation Specification for Apollo Guidance Equipment 2TV1
MA0610-015A	Contamination Control - Apollo Command Module and Service Module
SID 65-1642	Apollo Command Module/Service Module Measurement Requirements for Block II

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4.0 MATERIAL AND EQUIPMENT

4.1 The following test equipment shall be used to perform the requirements of this specification. If protection to personnel and equipment is not decreased, items, except government furnished parts, equivalent to those listed may be used.

ITEM	QUANTITY	DESCRIPTION
1	1	Digital Test Measurement System Model No. C14-206
2	1	Digital Test Command System, Model No. C14-207
3	1	Data Interleaver System, Model No. C14-232
4	1	External Digital Test Command Unit Model No. C14-231
5	1	S/C Ground Power Supply Model No. C14-418
6	1	Breakout Box, Test, Cm-SM Adapter Model No. C14-467
7	1	Electrical Cable Set, Model No. C34-391
8	1	Inertial Components Temperature Controller (ICTC) Model No. 513-100
9	1	PSA Adapter Module, Model No. A23-304
10	1	Optics Supporting Fixture Model No. A14-135
11	1	G&N Installation Qualification Fixture, Model No. A23-097
12	1	Theodolite (DKM 3 or equivalent) Model No. A23-079).
13	1	Retroreflecting Prism, Model No. A23-200
14	1	Portable Light Assembly Model No. A23-196
15	1	Vacuum Tube Volt Ohmmeter (VTVM)
16	1	Calculator (Friden or equivalent).
17	1	Movable Optics Target
18	1	SCT Resolution Check Card
19	1	Electrical Cable Portable G&N System, Model No. C14-462
20	1	Electronic Counter with Preset Counter (Hewlett Packard 5245L with 526A Preset Plug-In Unit, or equivalent)
21	1	Cable Set
22	1	Stopwatch

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- 5.1.2.5 Failure of the G&N System to pass any examination or test specified herein shall tentatively classify the G&N System as nonconforming. The normal test sequence may be continued on determination of the cause of the ~~nonconformance~~ if not detrimental to the G&N System on other interfacing subsystems. This determination shall have the concurrence of the G&N contractor test team. All nonconformance shall be investigated and cleared by waiver (FNN), correction of test specification, or hardware replacement. The suspected malfunctioning hardware shall be removed and returned to the laboratory, where the malfunction shall be verified. Only after malfunction verification shall a flight certified replaceable unit be installed in the G&N System.
- 5.1.2.6 The G&N System shall be operating in STANDBY mode with CMCpower applied for a minimum of two hours prior to torquing of inertial components. In the event STANDBY or CMCpower is interrupted, an equivalent time period shall be allowed when power is restored before transfer to the OPERATE mode, except that when the interval of interruption exceeds two hours, a two-hour warmup period shall be mandatory. Exceptions to the above are noted in 6.2.5.2.
- 5.1.2.7 The interruption of +28 VDC power to the G&N System through the Main A and Main B power busses shall be cause for the Command Module G&N System operator to immediately initiate the Emergency shutdown procedure (6.1.4) to preclude damage to the G&N System.

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5.2 Standard Environmental Conditions

5.2.1 The G&N System when installed in the Command Module shall be tested in an environment in accordance with ICD MH01-1348-416. At no time shall the dust particle count exceed Level 300,000 of Federal Standard 209 with more than 2,000 particles per cubic foot larger than 5 microns; no more than 35 particles larger than 65 microns with no more than 3 of these 35 larger than 100 microns in existence. Dust covers shall be installed on the SXT and SCT per ICD MH01-01350-116 when optics are not under test.

5.2.1.1 For periods of G&N Testing with the optical heads and the eyepieces of the SCT and SXT of the C/M G&N uncovered, or with the eyepieces removed, the environment shall meet at least the Class 100,000 particle size and count.

5.2.1.2 With the optical heads covered and the eyepieces installed or covered on the optical components (SXT, SCT), the ambient environmental shall meet the following conditions for particle size and count. No more than 200,000 particles 0.5 micron or larger per cubic foot with no more than 1,400 particles 5.0 microns or larger per cubic foot.

5.2.2 The APOLLO G&N System shall interface with a qualified ECS distribution system which shall supply coolant fluid during STANDBY and OPERATE control modes with flow rates and inlet temperatures as specified in ICD MH01-01349-416.

5.3 Test Equipment Tolerances

5.3.1 Measurements and tolerances are specifications stated herein are basic G&N system performance specifications. Calibration data must be supplied to the Acceptance Checkout Equipment (ACE) for the Power and Servo Assembly Adapter Module (PSAAM) and Signal Conditioner Assembly (SCA) performance. Final tolerances must include PSAAM and Signal Conditioner stability uncertainties (see appendix 1) as well as ACE and ACE carry-on conditioning uncertainties. All uncertainties due to instrumentation shall be root sum squared with the basic subsystem tolerance to yield an acceptable tolerance for use when testing the G&N system in the spacecraft.

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5.4 Test Sequence

- 5.4.1 The test sequence normally should follow the steps outlined by paragraph numbers in Table I in the order specified, except for 6.2.5, Turn-On and Turn-Off procedure, which may be performed as the requirement arises. This normal order may be deviated from, if necessary, as long as the sequences shown in the flow chart of Figure 1 are followed.

TABLE I TEST SEQUENCE

Paragraph No.	Test Title
6.1.3	Prepower Application Tests (Part of G&N Installation OCP)
6.2.1	Application of Standby Power to G&N System
6.2.2	CMC Operational Test
6.2.3	Operate Power On Test
6.2.4	G&N Power Supplies Test
6.2.5	General Turn Off and Turn On Procedure
6.2.6	G&N Operational Test
6.2.7	Gimbal Friction Test
6.2.8	G&N Panel Brightness & Lamp Test
6.2.9	Semi-Automatic Mode Control Test
6.2.10	Zero Optics Test
6.2.11	Optics Coordinate Transformation Control Test
6.2.12	Optics Positional Accuracy Test
6.2.13	Optics Slew Rate Test
6.2.14	Stabilization Loop Step Response Test
6.2.15	IRIG Scale Factor Test
6.2.16	IMU Performance Test
6.2.17	Fine Alignment Test SXT-NB-IMU
6.2.18	Gyrocompassing Test
6.2.19	Voltage Margin Test
6.2.21	S/C Control & Display Test

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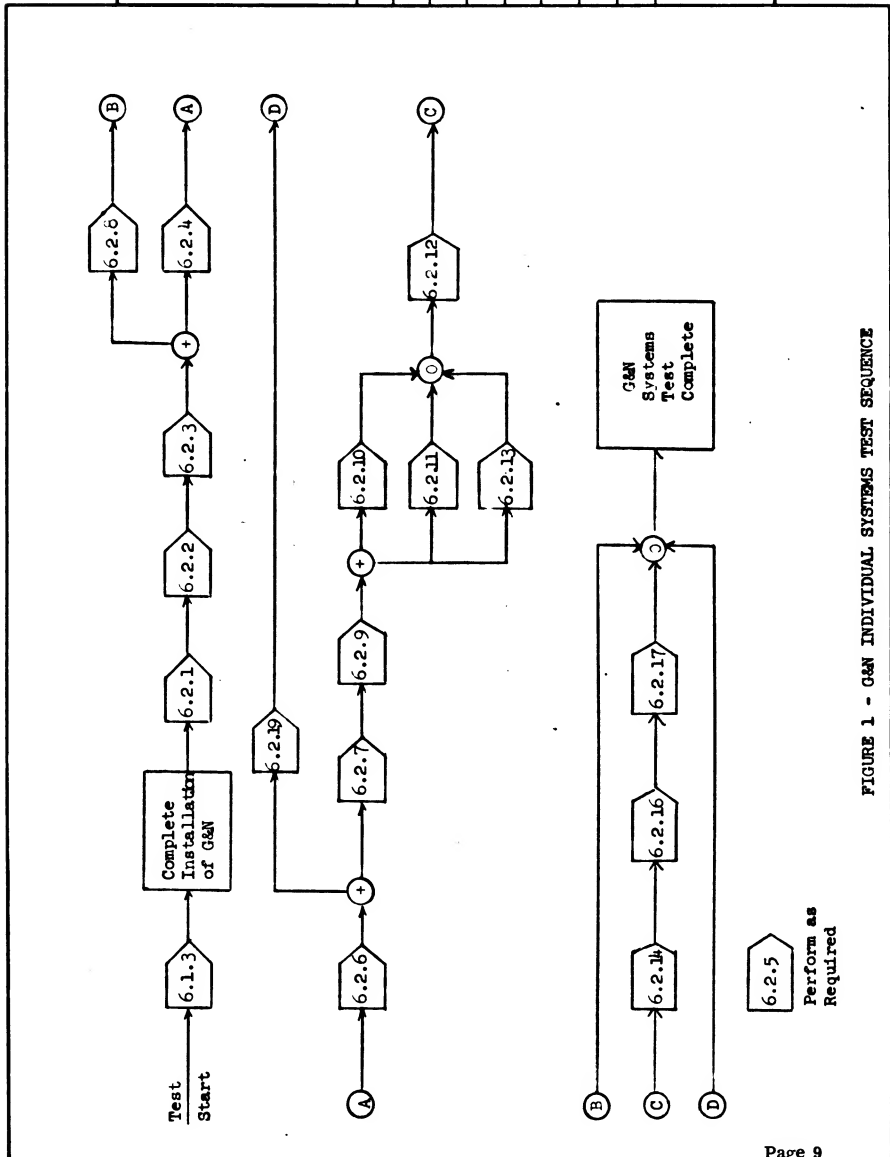


FIGURE 1 - G&N INDIVIDUAL SYSTEMS TEST SEQUENCE

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- 5.5 After the defective, replaceable element has been substituted with a flight certified unit, the G&N System checkout sequence shall regress to the rerunning of applicable portions of the selected sequence (by paragraph number) categorized by the subassemblies in which the malfunction occurred. The chosen subassembly categories are presented in Table II versus an appropriate retest paragraph sequence. Retest shall be conducted by performing applicable portions of all indicated paragraph numbers in the sequence listed as indicated under the appropriate subassembly heading. Retest shall proceed to the point in the normal test sequence at which the discrepancy was detected and corrected. Normal testing shall continue beyond this point in the specified sequence of Table I.
- 5.6 It is assumed that the Test Conductor has a working knowledge of the test equipment used; therefore, this procedure contains only the steps related directly to the G&N System components. If any questions arise concerning the test equipment, the Test Conductor should refer to the pertinent operational manuals.
- 5.7 The following requirements shall be completed before any of the tests in this specification are attempted.
- 5.7.1 The G&N System shall have been qualified in accordance with the requirements of PS 2015000.
- 5.7.2 The installation of the G&N System into the spacecraft shall have been completed as specified in Mechanical Installation Specification for Apollo Guidance Equipment Block II, MA0308-0107.
- 5.7.2.1 Interfacing systems (SCS, C & IS, EPS, ECS) shall have been verified to conform to loading and operational requirements as specified by the appropriate ICD.
- 5.7.3 All ACE equipment shall have been qualified in accordance with the respective quality assurance specifications prior to use with the G&N System.

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Table II. RETEST SEQUENCE

Paragraph Number	Test Title	IMU	Optics-Nav Base	AGC	PSA	LFB DSKY	MDC DSKY	Sig. Cond.	CDU	G&N Harness	PIPA Elect.	Indicator Control Panel	REVISION LETTER										PAGE
6.1.3	Pre-Power Application Tests	X		X																			
6.2.1	Application of Standby Power to G&N System	X																					
6.2.5	General Turn Off and Turn On Procedure	X	X	X	X	X	X	X	X	X	X	X											
6.2.3	Operate Power On Test																						
6.2.2	GMC Operational Test	X	X	X	X	X	X	X		X	X	X											
6.2.8	G&N Panel Brightness and Lamp Test		X																				
6.2.6	G&N Operational Test	X		X	X	X	X			X													
6.2.10	Zero Optics Test		X	X	X	X	X																
6.2.13	Optics Slew Rate Test		X	X	X	X	X	X	X														
6.2.11	Optics Coordinate Transformation Control				X																		
6.2.12	Optics Positional Accuracy Test		X	X	X			X	X	X	X	X											
6.2.9	Semi-Automatic Mode Control Test				X																		
6.2.14	Stab Loop Step Response Test	X			X																		
6.2.15	IRIG Scale Factor Test	X			X																		
6.2.16	IMU Performance Test	X			X																		
6.2.17	Fine Alignment Test	X	X		X				X	X	X	X											
6.2.19	Voltage Margin Test	X			X																		
6.2.7	Gimbal Friction Test	X			X																		
6.2.18	Gyrocompassing Test	X	X		X																		
6.2.4	G&N Power Supplies Test		X	X	X																		

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- 5.8 The following conditions are required for testing the G&N System.
- 5.8.1 Spacecraft systems other than the G&N System may be operating on a noninterfering basis while individual system checkout of the G&N System is being conducted.
- 5.8.2 The G&N System shall be supported by the Electrical Power System and Environmental Control System during operation in the Command Module. The Stabilization and Control System shall be connected to the G&N System during G&N operation in the Command Module for passive loading purposes if available.
- 5.8.3 During tests which interface with the Stabilization and Control System and the Central Timing System, operation of these systems shall be required.
- 5.9 The G&N System shall be tested per this specification after it is installed in the spacecraft. In the event that the installed system, or any assembly thereof, is removed from the spacecraft for modification, recycle, or any other reason, this process specification or pertinent portions of it shall be performed after the G&N System or assembly thereof, is reinstalled. Testing shall be limited to G&N System operation while actively connected to qualified spacecraft threshold systems, namely, the Electrical Power System (EPS), Environmental Control System (ECS), and Communication and Instrumentation System (C&IS) as much as possible. However, a minimum of combined and integrated system testing with the Stabilization and Control System (SCS), Central Timing System (CTS) and Caution and Warning System is required for complete G&N System verification.

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- 5.10 The test equipment listed in paragraph 4.1 shall be connected and ready for operation before the tests of this specification are initiated.
- 5.11 Data Records
- 5.11.1 All data concerning the checkout and operation of the G&N System as monitored via ACE, shall be recorded on the data sheets associated with their corresponding test. Out of tolerance readings shall be recorded and flagged by appropriate symbols.
- 5.11.1.1 All test data obtained while demonstrating the requirements of this document shall be permanently recorded and forwarded with the tested G&N to the next receiving agency.
- 5.11.1.2 A record of the amount of time each of the four prime power busses are on shall be kept and forwarded with the G&N to the next receiving agency.
- 5.12 Interface
- 5.12.1 The APOLLO G&N System shall interface with accepted ECS and EPS distribution systems for power and environment control purposes and with the SCS or SCS substitute system for signal interface in accordance with the applicable ICD's.

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6.0 DETAIL REQUIREMENTS

6.1 Initial Test Conditions

6.1.1 The following precautions shall be observed to preclude loss of continuity in inertial component performance history of the IMU. Deviation may necessitate recalibration of the inertial components.

6.1.1.1 The IMU shall be supplied with heater power on a continuous basis. When S/C Ground Power Supply, Model No. C14-418 is not providing heater power, then heater power shall be supplied through the Inertial Components Temperature Controller (ICTC) Model No. 513-100. The temperature of the IRIQ's shall be maintained between 120° and 150°F. The temperature of the PIPA's shall be maintained between 115° and 145°F.

6.1.1.2 The Standby Mode is identified by the circuit breakers IMU HTR MN A, IMU HTR MN B, COMPUTER MN A and MN B in the ON position and IMU MN A and MN B and the G&N Power-IMU switch on LEB Lighting Control Panel in the OFF position. The Operate Mode is identified by the circuit breaker IMU HTR MN A, MN B, COMPUTER MN A and MN B in the ON position and IMU MN A and MN B and the G&N Power-IMU switch on the LEB Lighting Control Panel in the ON position. The G&N System shall be operating in the Standby Mode with CMC power ON for a minimum of two hours prior to advancing to the IMU Operate Mode. In the event Standby or CMC power is interrupted, an equivalent time period shall be allowed when power is restored before advancing to the Operate Mode, except that when the interval of interruption exceeds two hours, a two-hour warmup period shall be mandatory (exceptions to the 2-hour warmup are noted in 6.2.5.2).

6.1.1.3 The Inertial Measurement Unit shall not be without heater power for more than 15 minutes.

6.1.1.4 During the turn on of the G&N power, COMPUTER MN A and MN B and IMU HTR MN A and IMU HTR MN B circuit breakers must be turned on before the IMU MN A and IMU MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. During the turn off of the G&N power the IMU MN A and IMU MN B circuit breakers must be turned off before the IMU HTR MN A and IMU HTR MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. In no case shall COMPUTER MN A and MN B circuit breaker be turned off before IMU MN A and MN B circuit breakers.

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- 6.1.1.5 A warmup period of 1 hour with OPERATE power applied shall be required prior to performing any test in which gyro and accelerometer parameters are measured, and 15 minutes warmup prior to any test in which precision amplitude and frequency power supply checks are made.
- 6.1.1.6 The following Command Module switches shall be in the position shown unless specifically directed otherwise in a procedural function.
- a. UP TIM switches on the LEB G&N Control Panel and MDC Panel 2 shall be set to ACCEPT.
 - b. LAUNCH VEHICLE - GUIDANCE switch on MDC Panel 2 shall be set to IU.
 - c. The SC CONT switch on MDC Panel 1 shall be set to CMC.
 - d. The CMC MODE switch on MDC Panel 1 shall be set to AUTO.
 - e. The Δ V CG switch on MDC Panel 1 shall be set to CSM.
 - f. The TRACKER switch on G&N Indicator Control Panel shall be set to OFF.
 - g. The LIGHTS-INTEGRAL control on the LEB Lighting Control Panel and the Left Hand Circuit Breaker panel shall be set to the minimum brightness - OFF position.
- 6.1.2 The following optical reference alignment requirements shall be demonstrated.
- 6.1.2.1 G&N Installation Qualification Fixture
- 6.1.2.1.1 The SXT Optical Reference No. 1 (Azimuth Autoset) LOS shall be located approximately 45 degrees (CW when viewed from above) from the SCZ axis measured in a horizontal plane. At this position, the Optical Reference shall be capable of being viewed through the SXT ST LOS.
- 6.1.2.1.2 The SXT Optical Reference LOS position with respect to the horizontal plane shall be known to within 5 arc-seconds. The azimuth bearing of the Optical Reference LOS shall be known to within ± 30 minutes of arc.
- 6.1.2.1.3 The SXT Optical Reference No. 2 LOS shall be located approximately 90 degrees from the SXT Optical Reference No. 1 (45 degrees from S/C Z axis) measured in a horizontal plane. At this position, the Optical Reference shall be capable of being viewed through the SXT STAR LOS.

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- 6.1.2.1.3.1 The SXT optical reference LOS position with respect to the horizontal plane shall be known to within 5 arc-seconds. The angle between Optical Reference No. 1 and No. 2 shall be known to within ± 30 seconds of arc.
- 6.1.2.1.4 SXT Optical Reference No. 3 shall be capable of being viewed through the SXT LLOS and the STAR LOS simultaneously at the Zero Optics position.
- 6.1.2.1.4.1 SXT Optical Reference No. 3 shall have the capability to measure the nonparallelism of the LLOS and STAR LOS to a resolution of 2 arc-seconds.

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6.1.3 Prepower Application Requirements

6.1.3.1 Prior to connecting G&N power connectors 56P30 and 56P31 to spacecraft power connectors CO3WLJ345 and CO3WLJ346, respectively, it is necessary to perform a complete verification of spacecraft power. Verification shall be performed with the installation of the G&N System complete except for connection of 56P30 and 56P31 to the S/C connectors.

6.1.3.2 Resistance Check on S/C Power Connectors.

6.1.3.2.1 Insure that the following switches and circuit breakers are set to the position indicated.

- a. GUIDANCE/NAVIGATION POWER AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- b. GUIDANCE/NAVIGATION IMU MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- c. GUIDANCE/NAVIGATION IMU HTR MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- d. GUIDANCE/NAVIGATION COMPUTER MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- e. GUIDANCE/NAVIGATION OPTICS MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- f. G/N POWER switch on the Right Hand Circuit Breaker Panel to OFF.
- g. G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.
- h. G/N POWER - IMU switch on the LEB Lighting Control Panel to OFF.

6.1.3.2.2 Obtain GSE tool consisting of connectors, extension cables, and connector terminal test box. Mate connectors P1 and P2 of the extension cables with S/C power connectors CO3WLJ345 and CO3WLJ346 respectively. Using a VIVOM measure the resistance between the terminals listed in Table I. Resistance measurements shall be as specified in Table I.

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TABLE I. RESISTANCE REQUIREMENTS FOR S/C POWER CONNECTORS

<u>Test No.</u>	<u>From</u>	<u>To</u>	<u>Requirements</u>
1	P1-2	P2-18 ↓	Open ↓
2	P1-5		
3	P1-6		
4	P1-7		
5	P1-8		
6	P1-9		
7	P1-10		
8	P1-11		
9	P1-12		
10	P1-13		
11	P1-14		
12	P1-17		
13	P2-2		
14	P2-5		
15	P2-6		
16	P2-7		
17	P2-8		
18	P2-9		
19	P2-10		
20	P2-11		
21	P2-12		
22	P2-13		
23	P2-14		
24	P2-17		
25	P1-1	P1-18 ↓	Continuity ↓
26	P1-3		
27	P1-4		
28	P1-15		
29	P1-16		
30	P2-1		
31	P2-3		
32	P2-4		
33	P2-15		
34	P2-16		

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6.1.3.3 Polarity and Voltage Check on S/C Power

6.1.3.3.1 Perform a voltage and polarity check of the G&N S/C power by performing the measurements indicated in Table II. Set the following switches to the position indicated.

- a. G/N POWER-OPTICS switch on the LEB Lighting Control Panel to ON.
- b. G/N POWER - IMJ switch on the LEB Lighting Control Panel to ON.
- c. G/N POWER switch on the Right Hand Circuit Breaker Panel to AC1.

For each measurement in Table II set the indicated circuit breaker on the Right Hand Circuit Breaker Panel to ON (breaker pushed in). After each measurement return the circuit breaker to OFF (breaker pulled out).

TABLE II. POLARITY & VOLTAGE REQUIREMENTS
FOR S/C POWER.

Test No.	Circuit Breaker	Polarity & Connector		Requirements
		Pin No.		
		Low	High	
1	COMPUTER MN A	P1-1	P1-2	+28.8 + 3VDC
2	OPTICS MN A	P1-14	P1-7	+28.8 + 3VDC
3	IMU MN A	P1-15	P1-9	+28.8 + 3VDC
		P1-16	P1-10	+28.8 + 3VDC
4	IMU HTR MN A	P1-3	P1-8	+28.8 + 3VDC
5	COMPUTER MN B	P2-1	P2-2	+28.8 + 3VDC
6	OPTICS MN B	P2-14	P2-7	+28.8 + 3VDC
7	IMU MN B	P2-15	P2-9	+28.8 + 3VDC
		P2-16	P2-10	+28.8 + 3VDC
8	IMU HTR MN B	P2-3	P2-8	+28.8 + 3VDC
9	POWER AC 1	P1-18	P1-17	115 + 10 VAC 400 + 7 cps
Set G/N POWER switch on the Right Hand Circuit Breaker Panel to AC 2.				
10	POWER AC 2	P1-18	P1-17	115 + 10VAC 400 + 7 cps

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- 6.1.3.3.2 Verify all circuit breakers exercised in Table II are in the OFF position (breakers pulled out). Set the following switches to the OFF position.
- a. G/N POWER - OPTICS switch on the LEB Lighting Control Panel.
 - b. G/N POWER - IMU switch on the LEB Lighting Control Panel.
 - c. G/N POWER switch on the Right Hand Circuit Breaker Panel.
- 6.1.3.3.3 Disconnect connectors P1 and P2 of the test cables from S/C connectors C03WLJ345 and C03WLJ346, respectively.
- 6.1.3.4 Resistance Check on G&N Power Connectors
- 6.1.3.4.1 Connect test cable connectors J1 and J2 to G&N connectors 56P30 and 56P31, respectively. Using a VTVM, measure the resistance between the terminals listed in Table III. The measurements shall meet the requirements listed in Table III.

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TABLE III. RESISTANCE REQUIREMENTS FOR G&N
POWER CONNECTORS

Test No.	From	To	Requirements (ohms)	Results
1	J1-15	J1-6	1000 to infinity	
2	J1-15	J1-14	1000 to infinity	
3	J1-15	J1-1	1000 to infinity	
4	J1-15	J1-18	5 meg to infinity	
5	J1-15	J1-16	0.0 to 0.5	
6	J1-15	J1-3	0.0 to 0.5	
7	J1-15	J2-15	0.0 to 0.5	
8	J1-14	J2-14	0.0 to 0.5	
9	J1-1	J2-1	0.0 to 0.5	
10	J1-6	J2-6	0.0 to 0.5	
11	J1-16	J2-16	0.0 to 0.5	
12	J1-3	J2-3	0.0 to 0.5	
13	J1-14	J1-6	1000 to infinity	
14	J1-1	J1-14	1000 to infinity	
15	J1-1	J1-6	0.0 to 2.0 infinity	
16	J1-18	J1-6	5 meg to infinity	
17	J1-18	J1-14	5 meg to infinity	
18	J1-18	J1-1	5 meg to infinity	
19	J1-2	J1-1	2.8 to infinity	
20	J1-9	J1-15	1.1 to infinity	
21	J1-10	J1-16	1.1 to infinity	
22	J1-7	J1-14	2.8 to infinity	
23	J1-8	J1-3	3.7 to infinity	
24	J1-17	J1-18	5 to 20	
25	J2-2	J2-1	2.8 to infinity	
26	J2-9	J2-15	1.1 to infinity	
27	J2-10	J2-16	1.1 to infinity	
28	J2-7	J2-14	2.8 to infinity	
29	J2-8	J2-3	3.7 to infinity	

6.1.3.5 Disconnect the test cable connectors J1 and J2 from G&N power connectors 56P30 and 56P31, respectively. Mate G&N connector 56P30 to S/C connector C03WLJ345 and mate G&N connector 56P31 to S/C connector C03WLJ346. Mate G&N connector 56P32 to S/C connector C03WLJ347.

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6.1.4 Emergency Shutdown Procedure

CAUTION: In the event of a malfunction occurrence which could damage the G&N System before the normal shutdown procedure 6.2.5 could be performed, the following sequence should be utilized in the spacecraft.

- 6.1.4.1 On the LEB Lighting Control Panel set the G/N POWER-IMU and G/N POWER - OPTICS switches to OFF.
- 6.1.4.2 On the Right Hand Circuit Breaker Panel set the following switches and circuit breakers to OFF (breakers pulled out).
- a. GUIDANCE/NAVIGATION COMPUTER MN A and MN B
 - b. GUIDANCE/NAVIGATION IMU HTR MN A and MN B
 - c. G/N POWER switch to OFF
 - d. GUIDANCE/NAVIGATION IMU MN A and MN B
 - e. GUIDANCE/NAVIGATION OPTICS MN A and MN B
 - f. GUIDANCE/NAVIGATION POWER AC 1 and AC 2
- 6.1.4.3 Verify that the ICTC is providing heater power to the G&N System.

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- 6.2 Test Procedures
- 6.2.1 Application of Standby Power to G & N System
- 6.2.1.1 Verify that spacecraft power checks, to include polarity and magnitude on Spacecraft Power Connector, have been made as specified in 6.1.3.
- 6.2.1.2 All power and control switches on the G & N Indicator Control Panel shall be placed in the OFF or neutral position.
- 6.2.1.3 The Inertial Component Temperature Controller (ICTC), shall be supplying inertial component heater power to the G & N System through the PSA, Connector No. 45J2.
- 6.2.1.4 Computer Power On
- 6.2.1.4.1 Set G & N COMPUTER MN A and MN B Breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in).
- 6.2.1.4.2 Set the POWER-AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in), and position G/N POWER switch to AC1.
- 6.2.1.4.3 Set the computer numerical display lights to the minimum acceptable brightness by rotating the BRIGHTNESS Controls on the MDC and LEB Lighting Control Panels.
- 6.2.1.4.4 The CMC +28 VDC power discrete shall be issued (CG 1523). This can be observed by the lighted CMC +28 VDC operate lamp on the Event Module. The +28 VDC CMC OPERATE voltage (CG 1520) shall be $+28.8 \pm 3$ VDC. Verify CRT indication.
- 6.2.1.4.5 Using DSKY, enter VERB 36, ENVR, then press RESET. All computer alarms on the Main Display Console (MDC), LEB CMC DSKY and CRT shall clear.
- 6.2.1.4.6 The voltage output of the +4 VDC CMC supply shall be $+4.00 \pm 0.20$ VDC, (CG 1030). The value on the CRT shall be recorded.
- 6.2.1.4.7 The voltage output of the +14 VDC CMC supply shall be $+14.0 \pm 0.4$ VDC, (CG 1020). The value on the CRT shall be recorded.
- 6.2.1.4.8 Verify that the CMC is in the Backup Mode by monitoring on the CRT that the Program indicates 00, and the program readouts on the MDC and LEB AGC DSKY indicate 00.

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6.2.1.4.9 Zero the CMC erasable memory by entering the following sequence into the K-start:

- a. VERB 57, ENTER
- b. 00015, ENTER

6.2.1.4.10 Initiate CMC self-check by entering the following sequence into the K-start:

- a. VERB 21, NOUN 27 ENTER
- b. 77777, ENTER
- c. VERB 05 NOUN 01 ENTER
- d. 1366, ENTER

6.2.1.4.10.1 Monitor DSKY until R3 (SCOUNT +2) increments twice. If an error is detected, the following will be displayed:

R1 = 01102
R2 = XXXXX C (SFALL)
R3 = XXXXX C (ERCOUNT)

6.2.1.4.10.2 Enter the following into the K-start:

- a. VERB 21
- b. NOUN 27, press ENTER pushbutton
- c. 00000, press ENTER pushbutton

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6.2.1.5 IMU HTR Heater Power On

6.2.1.5.1 Enter the IMU Standby Mode of operation by engaging the IMU HTR MN A and MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).

6.2.1.5.2 Verify that the IMU +28 VDC STANDBY discrete lamp on Event Module is illuminated (CG 1513).

6.2.1.5.3 Record the value of the following signals displayed on the CRT.

Signal	Requirement
a. CG 1331 28V 3200 CPS POWER SUPPLY FEEDBACK	28.6 ± 0.6 VRMS
b. CG 1510 + 28 VDC STANDBY POWER	28.8 (±3) VDC

6.2.1.5.4 The PIPA TEMP on the CRT shall be monitored at 15 min., 1 hr. and 2 hrs. from execution of 6.2.1.5.2 to insure that the PIPA Temperature Control Loop circuitry is operating to maintain a temperature of $130.5 \pm 1.5F$ (CG 2300).

6.2.1.5.5 The IRIG TEMP on the CRT shall be monitored at 15 min., 1 hr., and 2 hrs. after 6.2.1.5.2 is executed to insure that the IRIG Temperature (CG 2301) is within 3.0 degrees of the PIPA Temperature.

6.2.1.5.6 At the termination of the 2-hour period, record the PIPA Temperature (CG 2300) and the IRIG Temperature (CG 2301) on the CRT.

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6.2.2 CMC Operational Test

NOTE: This test shall be performed when only IMU HTR and Computer Power is applied. The test shall not be performed when IMU OPERATE power is applied.

6.2.2.1 Verify that IMU STANDBY power (including CMC operate power) is applied, IMU OPERATE power is not applied. (G & N IMU HTR MN A and MN B breakers engaged, Computer MN A and MN B breakers engaged, IMU MN A and MN B breakers disengaged, G/N Power-IMU switch on LEB Lighting Control Panel in OFF Position).

6.2.2.1.1 Using the LEB CMC DSKY, enter VERB 36, ENTER then press RESET.

6.2.2 CMC Checks

6.2.2.1 Using the LEB CMC DSKY, enter the following sequence of data into the CMC to initiate the DSKY check. Press the ENTER pushbutton after each entry (denoted by E).

VERB 21 NOUN 27, E
77766, E

6.2.2.2 DSKY check shall check all the electroluminescent elements by displaying the decimal numbers from nine through zero in succession, each set of numbers shall be displayed for approximately 5 seconds. Verify all elements operable on MDC and LEB CMC DSKY's. VERB-NOUN display shall flash.

6.2.2.2.1 Minus and plus signs shall be displayed. Verify operation on MDC and LEB DSKY's.

6.2.2.2.2 COMP ACTY lamp shall be illuminated for approximately 5 seconds, then DSKY shall blank.

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6.2.2.3 CAUTION and STATUS Displays

6.2.2.3.1 Enter VERB 35, ENTR, into LEB CMC DSKY.

6.2.2.3.2 The following MDC and LEB CMC DSKY displays shall illuminate for approximately 5 seconds.

- a. UPLINK ACTY
- b. NO ATT
- c. STEY
- d. KEY REL Flashing
- e. TEMP
- f. GIMBAL LOCK
- g. PROG
- h. RESTART
- i. TRACKER
- j. OPR ERROR Flashing
- k. COMP ACTY
- l. VERB-NOUN Flashing
- m. Plus 88888 in R1, R2, and R3

After indications a through l go out +88888 shall remain in R1, R2, R3.

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6.2.2.4 DSKY Pushbutton Check

6.2.2.4.1 Enter the following sequence into the LEB CMC DSKY. Press the ENTER pushbutton after each entry (denoted by E).

- a. VERB 25 NOUN 01, E
- b. 01600, E
- c. +00123, E
- d. -00456, E
- e. -00789, E

6.2.2.4.2 The LEB CMC DSKY shall indicate +00123 in R1, -00456 in R2, and -00789 in R3.

6.2.2.4.3 Enter VERB 05, NOUN 01 into the LEB CMC DSKY. Press the ENTER pushbutton.

6.2.2.4.4 Enter 01600 into LEB CMC DSKY. Press the ENTER pushbutton. The LEB CMC DSKY shall indicate 00024 in R1, 77664 in R2, and 77576 in R3. Verify.

6.2.2.4.5 Repeat of 6.2.2.4.1 through 6.2.2.4.4 using the MDC CMC DSKY. The results shall be as specified in 6.2.2.4.4.

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- 6.2.2.5 Uplink and Downlink Checks.
- 6.2.2.5.1 Enter VERB 36 into K148. Press the ENTER pushbutton, then press ERROR RESET pushbutton.
- 6.2.2.5.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.
- a. VERB 25 NOUN 01 ENTER
 - b. 01600, ENTER
 - c. 00000, ENTER
 - d. 77777, ENTER
 - e. 07254, ENTER
 - f. VERB 05 NOUN 01, ENTER
 - g. 01600, ENTER
- 6.2.2.5.3 CMC Registers R1, R2, and R3 display on the CRT shall indicate 00000, 77777, and 07254, respectively.
- 6.2.2.6 CMC Automatic Self-Test
- 6.2.2.6.1 Enter the following into the K - Start:
- a. VERB 21 NOUN 27, press ENTER pushbutton
 - b. 00000, press ENTER pushbutton

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6.2.2.7 Parity Fail Test

6.2.2.7.1 Enter the following into the K-Start. Press the ENTER pushbutton after each entry.

- a. VERB 57, ENTER
- b. 00015, ENTER
- c. VERB 21 NOUN 02, ENTER
- d. 01600, ENTER
- e. 33777, ENTER
- f. VERB 25 NOUN 26, ENTER
- g. 04000, ENTER
- h. 01600, ENTER
- i. 00003, ENTER
- j. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.7.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.7.3 Enter VERB 36, into the K-START. Press the ENTER pushbutton.

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6.2.2.8 Rupt Lock Test

6.2.2.8.1 Enter the following sequence into the K-Start. Press the ENTER pushbutton after each entry.

- a. VERB 24 NOUN 01, ENTER
- b. 01600, ENTER
- c. 30001, ENTER
- d. 01600, ENTER
- e. VERB 25 NOUN 26, ENTER
- f. 00001, ENTER
- g. 01600, ENTER
- h. 00003, ENTER
- i. VERB 31, ENTER

The RESTART lamps on the MDC and LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.8.2 Press the ERROR RESET pushbutton on the K-START. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.8.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

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6.2.2.9 TC Trap Test

6.2.2.9.1 Enter the following sequence into the K-Start. Press the ENTER pushbutton after each entry.

- a. VERB 21 NOUN 02, ENTER
- b. 01600, ENTER
- c. 01600, ENTER
- d. VERB 25 NOUN 26, ENTER
- e. 04000, ENTER
- f. 01600, ENTER
- g. 00003, ENTER
- h. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.9.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.9.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

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6.2.2.10 Nightwatchman Test

6.2.2.10.1 Enter the following sequence into the K-Start. Press ENTER pushbutton after each entry.

- a. VERB 24 NOUN 01, ENTER
- b. 01600, ENTER
- c. 30001, ENTER
- d. 01600, ENTER
- e. VERB 25 NOUN 26, ENTER
- f. 04000, ENTER
- g. 01600, ENTER
- h. 00003, ENTER
- i. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on MDC and LEB CMC DSKY and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.10.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.10.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

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6.2.2.11 CMC Clock Frequency Test

6.2.2.11.1 Insure that the AGC has been operating for at least 15 min. before performing this test.

6.2.2.11.2 Insure that the IMU 3.2 kc 28 V Supply is available on the vertical input to PIPA Scope.

6.2.2.11.3 Insure that the EPUT Meter and preset counter plug-in unit are connected to 115V, 60 cps power.

6.2.2.11.3.1 Permit the EPUT to warm up for the length of time required by the manufacturer's specification.

6.2.2.11.4 Connect the signal output from Oscilloscope 4A4-A1 to the input channel on the EPUT Meter.

6.2.2.11.5 Set the preset counter to indicate 96000.

6.2.2.11.6 Set the EPUT meter to count at the maximum count rate (1 megacycle or greater).

6.2.2.11.7 Adjust the Trigger Level to the point midway between the range over which the counter will normally count.

6.2.2.11.8 Each count cycle shall last approximately 30 seconds. Adjust the display time to permit recording the display on the EPUT.

6.2.2.11.9 Record the results of 10 count-cycles. Calculate the average time per cycle over the 10 cycles. Record the result.

6.2.2.11.10 Divide 96000 by the average time from 6.2.2.11.9. Record the result as 3200 cps frequency.

6.2.2.11.11 Multiply the 3200 cps frequency by 40. Record the result as the AGC clock frequency.

6.2.2.11.11.1 The AGC Clock Frequency shall be 2048000 ± 5 cps.

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6.2.3 Operate Power On Test

6.2.3.1 IMU Operate Power On

CAUTION: The sequences specified in this test must be adhered to. Deviations may necessitate recalibration of the inertial components.

NOTE: Disregard the GIMBAL LOCK indicator until the completion of step 6.2.3.1.6.

6.2.3.1.1 The following Command Module switches and circuit breakers shall be in the following state:

Right Hand Circuit Breaker Panel

- a. GUIDANCE/NAVIGATION COMPUTER MN A and MN B breakers on (pushed in)
- b. GUIDANCE/NAVIGATION IMU HTR MN A and MN B breakers on (pushed in)
- c. GUIDANCE/NAVIGATION IMU MN A and MN B breakers off (pulled out)
- d. GUIDANCE/NAVIGATION OPTICS MN A and MN B breakers off (pulled out)

LEB Lighting Control Panel

- e. G/N Power - IMU set to OFF
- f. G/N Power - Optics set to OFF

6.2.3.1.2 Switches and selectors on the G & N Indicator control panel shall be set as follows:

- a. OPTICS MODE to MANUAL
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to MED
- d. TELESCOPE TRUNNION to SLAVE to SXT
- e. RETICLE BRIGHTNESS to minimum brightness position

6.2.3.1.3 Adjust the Command Module MDC and LEB Lighting Controls to minimum intensity for proper readout of G & N Displays.

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6.2.3.1.4 Set up the ACE analog recorders to monitor the following measurements (set chart speed to 5 mm/sec):

- a. CG 2117 IGA Servo Error In Phase
- b. CG 2177 OGA Servo Error In Phase
- c. CG 2147 MGA Servo Error In Phase
- d. CG 2112 IG IX Resolver Output Sin
- e. CG 2172 OG IX Resolver Output Sin
- f. CG 2142 MG IX Resolver Output Sin
- g. CG 1040 +120 VDC PIPA Supply DC Level

CAUTION: Before proceeding, insure that the G & N System has been operating in the STANDBY MODE (power configuration as defined in 6.2.3.1) for a minimum period of 2 hours. Exceptions to this requirement are noted in 6.2.5.2.9.

CAUTION NOTE: If the requirements of 6.2.3.1.6 are not met, remove IMU operate power immediately by placing the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

6.2.3.1.5 Perform the following sequence:

- a. Turn on the IMU MN A and MN B circuit breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).
- b. Start Analog Recorders.
- c. Place G/N Power - IMU switch on the LEB Lighting Control Panel to IMU (switch toggle up).

6.2.3.1.6 Immediately begin monitoring the following measurements.

- a. The IMU Operate Power is $\pm 28.8 \pm 3\text{VDC}$ (OG 1500). Verify on CRT.
- b. On the recorders, verify that oscillations are not sustained and that a null is achieved within 10 seconds of power application in 6.2.3.1.5 on the following measurements:

CG 2112, IG IX Resolver Output Sin
CG 2142, MG IX Resolver Output Sin
CG 2172, OG IX Resolver Output Sin

- c. On the CRT, verify the absence of the +120 VDC PIPA supply (CG 1040) for a period of 90 + 10 seconds following power application in 6.2.3.1.5. After approximately 100 seconds, the voltage shall read +120 \pm 6 VDC.

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- 6.2.3.1.7 Insure that the following alarm lamps are not lighted on G & N LEB Display Panel.
- a. CMC Warning
 - b. ISS Warning
 - c. PGNS Caution
- 6.2.3.1.8 Verify that the PROGRAM ALARM lamp on the DSKY's does not light with VERB 05 NOUN 31 and R1 = 00213 displayed.
- 6.2.3.1.9 The OG, IG, and MG CDU angles shall be 00000 \pm 00150. Verify on CRT.
- 6.2.3.1.10 Verify that the following secondary power supply voltages are not flashing on the CRT display.

Table VI. Secondary Power Supply Voltages

Meas. No.	Signal
1 CG 1040	+120 VDC PIPA SUPPLY
2 CG 1051	+20 VDC PIPA SUPPLY
3 CG 1052	-20 VDC PIPA SUPPLY
4 CG 1070	+4 VDC CDU SUPPLY
5 CG 1100	-28 VDC ELECTRONICS
6 CG 1020	+14 VDC CMC SUPPLY
7 CG 1030	+4 VDC CMC SUPPLY
8 CG 1201	IMU 28 V 800 CPS 1 pct 0 ph
9 CG 1202	IMU 28 V 800 CPS 5 pct ph A
10 CG 1203	IMU 28 V 800 CPS 5 pct ph B
11 CG 1331	3.2KC 28 V SUPPLY
12 CG 1110	2.5 VDC TM BIAS

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- 6.2.3.2 Optics Power On
- 6.2.3.2.1 Optics power shall be applied by actuating the G & N OPTICS MN A and OPTICS MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in), and placing G/N Power -OPTICS switch on the LEB Lighting Control Panel to ON.
- 6.2.3.2.2 OPTICS +28 VDC discrete shall be issued (CG 1533). Verify by observing that the OPTICS lamp on Event Module is illuminated. Verify that the +28 VDC OPTX OPERATE BUS (CG 1530) is $+28.8 \pm 3$ VDC. Record the indication on the CRT.
- 6.2.3.2.3 Verify the following secondary power supply voltages on the CRT are not flashing:
- CG 1211 OPTX 28 V 800 CPS 1 pct 0 ph
CG 1212 OPTX 800 CPS 5 pct-90ph
- 6.2.3.3 Enter and verify VERB 40 NOUN 20 into K148. Press the ENTER pushbutton to advance the system to the Zero CDU mode.
- 6.2.3.4 Enter and verify VERB 41, NOUN 20 into K148. Press the ENTER pushbutton to advance the system to Coarse Align under CMC control. The VERB NOUN display on CRT shall flash and indicate 21-22.
- 6.2.3.5 Enter and verify +00000 into K148 three times, pressing the ENTER pushbutton after each entry.

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6.2.4 G & N System Power Supplies Test

6.2.4.1 Proceed with this test if 6.2.3, Operate Power On Test, has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding with this test. Insure that the IMU Operate Power has been on for at least 15 minutes before proceeding with this test.

6.2.4.2 Enter the following sequence into the K-Start. Verb 41 NOUN 20, ENTER; +00000 ENTER; +00000 ENTER, +00000 ENTER.

6.2.4.3 Insure that OPERATE power has been applied for at least 15 minutes. Verify that the discretes listed below have been issued by noting that the event lamps on the specified Event Module are illuminated.

- a. IMU STANDBY POWER (CG 1513)
- b. CMC OPERATE POWER (CG 1523)
- c. OPTX OPERATE POWER (CG 1533)

6.2.4.4 The IRIG and PIPA Pulse Torque DC supply shall demonstrate the following requirements. The DC output voltages shall be as follows. Record the indicated voltages on the CRT.

- a. The 120 volt PIPA Power Supply output voltage shall be 120 ± 6 VDC (CG 1040).
- b. The PIPA +20 VDC Supply output voltage shall be $+20 \pm 1.2$ VDC (CG 1051).
- c. The PIPA -20 VDC output voltage shall be -20 ± 2 VDC (CG 1052).

6.2.4.5 The minus 28 VDC Electronics Power Supply output voltage shall be -27.5 ± 6.0 VDC (CG 1100). Record the indicated voltage displayed on the CRT.

6.2.4.6 Power Supplies

Record the indicated voltage display on the CRT.

- a. The +14 VDC CMC Power output voltage shall be $+14.0 \pm 0.4$ VDC (CG 1020).
- b. The +4 VDC CMC Power Supply output voltage shall be $+4.00 \pm 0.20$ VDC (CG 1030).
- c. The +4 VDC CDU Power Supply output voltage shall be $\pm 4.0 \pm 0.2$ VDC.

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6.2.4.7 Twenty-eight volt, 800 CPS Power Supplies - the following values shall be measured with the guidance reference clock synchronizing input pulses. Record the indicated voltage displayed on the CRT.

- a. IMU +28 V, 800 CPS 1 per cent 0 degree voltage shall be 28.0 ± 0.6 VAC (CG 1201).
- b. IMU 28 V, 800 CPS, 5 per cent Ph A -90 degree voltage shall be 28.0 ± 1.4 VAC (CG 1202).
- c. IMU +28 V, 800 CPS 5 per cent Ph B 0 degree voltage shall be 28.0 ± 2.1 VAC (CG 1203).
- d. Optics +28 V, 800 CPS 1 per cent 0 degree voltage shall be 28.0 ± 0.6 VAC (CG 1211).
- e. Optics +28 V, 800 CPS 5 per cent -90 degree voltage shall be 28.0 ± 1.5 VAC (CG 1212).

6.2.4.8 IMU 3200 CPS Supply

The 28 V 3200 CPS Supply feedback output voltage shall be 28.6 ± 0.6 volts RMS (CG 1331). Record the indicated voltage displayed on the CRT.

6.2.4.9 Plus 28 VDC Busses

Record the indicated voltage displayed on the CRT.

- a. The +28 VDC IMU OPERATE (Buss No. 1) output voltage shall be $28.8 (+3, -3)$ VDC under normal system load (CG 1500).
- b. The +28 VDC IMU STANDBY (Buss No. 2) output voltage shall be $28.8 (+3, -3)$ VDC under normal system load (CG 1510).
- c. The +28 VDC IMU STANDBY (Buss No. 3) output voltage shall be $28.8 (+3, -3)$ VDC under normal system load (CG 1520).
- d. The +28 VDC OPTX OPERATE (Buss No. 4) output voltage shall be $28.8 (+3, -3)$ VDC under normal system load (CG 1530).

6.2.4.10 Noise

- a. The +14 VDC CMC Power Supply RMS noise shall be less than 0.4 volt (CG 1021).
- b. The +4 VDC CMC Power Supply noise peak shall be less than 0.4 volt pp (CG 1031).

6.2.4.11 IMU 14/CMC Sync Phase Difference

The Phase difference between the 3.2 kc supply and CMC sync shall be $0^\circ \pm 10^\circ$ (NG 1336). Record the phase difference as indicated on the CRT.

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6.2.4.12 Miscellaneous Checks. - The following miscellaneous signals are required to supply data for system evaluation in event of failure, or for trend analysis of system performance. Record the values of the following signals displayed on the CRT.

- a. CG 4300 CMC Temperature
- b. CG 6020 PIPA Calibration Module Temperature
- c. CG 6021 IMU 800 CPS 5 per cent Temperature

6.2.4.13 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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6.2.5 General Turn Off and Turn On Procedure

NOTE: This procedure shall be utilized any time after performing 6.1.3 Prepower Application Requirements, 6.2.1, Standby Power On Test, and 6.2.3. Operate Power on Test, to turn on or turn off the G&N System. Appropriate portions of this procedure will be referenced in other tests.

6.2.5.1 Turn Off Procedure

CAUTION: This procedure must be performed in the sequence specified. Failure to adhere to this sequence may require calibration of the inertial components.

6.2.5.1.1 Enter the following sequence into the K-148.

- a. VERB 41 NOUN 20, ENTER
- b. +00000 ENTER
- c. +00000 ENTER
- d. +09000 ENTER

Verify that the GIMBAL LOCK indicator on the DSKY's is illuminated.

6.2.5.1.2 Set the following switches on the G&N Indicator Control Panel to the positions designated.

- a. OPTICS MODE to MANUAL
- b. CONTROLLER MODE to DIRECT
- c. CONTROLLER SPEED to MED
- d. TELESCOPE TRUNNION to SLAVE TO SXT
- e. RETICLE BRIGHTNESS to minimum brightness position

6.2.5.1.3 Set the G/N Power - IMU switch on the LEB Lighting Control Panel to OFF and G&N IMU MN A and MN B circuit breakers on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).

6.2.5.1.4 Decrease the LIGHTS - NUMERICS controls on both the Left Hand Circuit Breaker panel and the LEB Lighting Control Panel to the minimum brightness - OFF position.

6.2.5.1.5 Set the IMU HTR MN A and MN B circuit breaker on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).

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- 6.2.5.1.6 Set the COMPUTER MN A and MN B Circuit breakers on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).
- 6.2.5.1.7 Set the G&N Power AC1-OFF-AC2 Switch on the Right Hand Circuit breaker panel to OFF and the G&N POWER AC1 and AC2 circuit breakers to OFF (breakers pulled out).
- 6.2.5.1.8 Set the G/N POWER - OPTICS switch on the LEI Lighting Control Panel to OFF and G&N OPTICS MN A and MN B breakers on the Right Hand circuit breaker panel to OFF.
- 6.2.5.1.9 Verify that the ICTC is supplying inertial components heater power to the G&N System. This will be indicated by the following on the PTC.
 - a. G&N ON (PTC inhibit) light not illuminated.
 - b. IMU Temp/heater current meter indicates IMU temperature of $130^{\circ} \pm 5^{\circ} \text{F}$.
- 6.2.5.2 Turn ON Procedure
 - 6.2.5.2.1 Set or verify the following G&N Indicator Control Panel switches to the position indicated.
 - a. CONDITION LAMPS to ON
 - b. OPTICS MODE to MANUAL
 - c. CONTROLLER COUPLING to DIRECT
 - d. CONTROLLER SPEED to DIRECT
 - e. TELESCOPE TRUNNION to SLAVE to SXT
 - f. RETICLE BRIGHTNESS to minimum brightness position.
 - 6.2.5.2.2 Insure that interfacing system EPS and ECS are turned on and operating properly.

CAUTION: The remaining procedure must be followed in sequence specified. Failure to adhere to this sequence may require recalibration of the inertial components.

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- 6.2.5.2.3 Energize the G&N COMPUTER MN A and MN B breakers on the Right Hand Circuit Breaker panel (breakers pushed in). If the STBY indicator on the DSKY is illuminated, press the STBY pushbutton for approximately 3 seconds until the STBY indicator extinguishes. Enter VERB 61 into K148 and press the ENTER pushbutton. Insure that the CMC +28 VDC discrete lamp on the Event Module is illuminated (CG 1523). Verify +14 and +4 VDC AGC power supply outputs on CRT display. Voltages shall be $+14 \pm 0.4V$ (CG 1020) and $+4 \pm 0.2$ (CG 1030).
- 6.2.5.2.4 Set the G&N POWER AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in). Set the G&N POWER AC1-OFF-AC2 switch to AC1.
- 6.2.5.2.4.1 Set the G&N DSKY and Display Panel brightness to the minimum acceptable level by manipulation of LIGHTS - NUMERICS control on both Left Hand circuit breaker panel and LEB lighting Control panel.
- 6.2.5.2.5 Energize the G&N IMU HTR, MN A and MN B breakers on the Right Hand Circuit Breaker panel (breakers pushed in).
- 6.2.5.2.6 Disregard all alarm indication on the CMC DSKY panels. Enter VERB 36 into K148. Press ENTER pushbutton. Press ERROR RESET pushbuttons on K-Start. All computer alarms except the Gimbal Lock Indicator on the Main Display Console (MDC) and LEB AGC DSKY shall clear. Verify registers R1, R2, and R3 on the DSKY's are cleared.
- 6.2.5.2.7 Clear the CMC erasable memory by entering the following sequence into the K-Start.
- VERB 57, press ENTER
 - 00015, press ENTER

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6.2.5.2.8 Enter the following into the K-Start:

- a. VERB 21
- b. NOUN 27 ENTER
- c. 00000, ENTER

NOTE: Allow 2 hours to elapse before proceeding to 6.2.5.2.9 with the following exceptions:

- a. If the G&N System has been in the power off state for less than 5 days with the gimbals in the parked position (0°, 0°, 90°) and the system has not been moved, allow 90 seconds to elapse before proceeding.
- b. If the G&N System has been turned off for less than 15 minutes allow 90 seconds to elapse before proceeding.
- c. If the G&N System has been turned off with the gimbals in the unparked position for more than 15 minutes but less than 2 hours allow a warmup time equal to the time off to elapse before proceeding.

CAUTION: If the requirements of 6.2.5.2.10 are not met, remove IMU Operate Power immediately by setting the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

6.2.5.2.9 After the required warmup time has elapsed set the G&N IMU MN A and MN B circuit breaker on the Right Hand circuit breaker panel to ON (breaker pushed in), and the G/N POWER - IMU switch on the LEB Lighting Control panel to the ON position (toggle up).

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- 6.2.5.2.10 Immediately begin monitoring the following measurements.
- On the CRT verify that IMU Operate Power is $\pm 28.8 \pm 3$ VDC (CG 1500).
 - On the meter modules verify that oscillations are not sustained and that a null is achieved within 10 seconds of power application on the following measurements:
 - CG 2112 IG 1X Resolver Output Sin
 - CG 2142 MG 1X Resolver Output Sin
 - CG 2172 OG 1X Resolver Output Sin
 - On the CRT verify the absence of the +120 VDC PIPA Supply (CG 1040) for a period of 90 ± 10 seconds following power application. After approximately 100 seconds, the voltage shall read $+120 \pm 6$ VDC.
- 6.2.5.2.11 Verify that the PROGRAM ALARM lamp on the DSKY's does not light with VERB 05 NOUN 31 and R1 = 00213 displayed.
- 6.2.5.2.12 Enter and verify VERB 40, NOUN 20 into K148. Press the ENTER pushbutton.
- 6.2.5.2.13 Enter and verify VERB 41, NOUN 20 into K148. Press the ENTER pushbutton to advance the System to the Coarse Align mode. The VERB-NOUN display on the CRT shall flash and indicate 21-22.
- 6.2.5.2.14 Enter and verify +00000 into K148 three times, pressing the ENTER pushbutton on the K-START after each entry.
- 6.2.5.2.15 Set the G&N OPTICS MN A and MN B circuit breakers on the Right Hand circuit breaker panel to the ON position (breaker pushed in).

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- 6.2.5.2.16 Verify that the CRT indications of the signals in Table VI are not flashing.

Table VI. Secondary Power Supply Voltages

Measurement Number	Signal
1 CG 1040	+120 VDC PIPA SUPPLY
2 CG 1051	+20 VDC PIPA SUPPLY
3 CG 1052	-20 VDC PIPA SUPPLY
4 CG 1070	+4 VDC CDU SUPPLY
5 CG 1100	-28 VDC ELECTRONICS
6 CG 1020	+14 VDC CMC SUPPLY
7 CG 1030	+4 VDC CMC SUPPLY
8 CG 1201	IMU 28V 800 CPS 1 pct 0 ph
9 CG 1202	IMU 28V 800 CPS 5 pct ph A
10 CG 1203	IMU 28V 800 CPS 5 pct ph B
11 CG 1331	3.2 KC 28V SUPPLY
14 CG 1110	2.5 VDC TM BIAS
15 CG 2300	PIPA TEMPERATURE
18 CG 2301	IRIG TEMPERATURE

- 6.2.5.2.17 Monitor the PIPA Display Scope to insure that each PIPA is moding properly.

- 6.2.5.2.18 Perform 6.2.6 G&N Operational Test.

- 6.2.6 G&N Operational Test

- 6.2.6.1 Initial Conditions

Proceed with this test if the Operate Power On Test of 6.2.3 or the Turn On Procedure of 6.2.5 has been completed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding.

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6.2.6.2 Initiation

6.2.6.2.1 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.6.2.2 Enter 00004 into K148. Press the ENTER pushbutton.

6.2.6.2.3 Verify that the PROGRAM display on the CRT indicates 07.

NOTE: During this portion of the test the G&N System is exercised through its modes. Any failures will be indicated by the PROGRAM ALARM lamp on the DSKY's lighting with VERB 05 NOUN 31 and R1 = 01411 displayed.

6.2.6.2.4 After approximately 12 minutes, VERB 06, NOUN 66 will flash and the value of the gravity vector in cm/sec^2 shall be displayed in R1 and R2 on the CRT. Record these values.

6.2.6.2.5 R1 contains the first five digits of the gravity vector and R2 contains the last five digits. A decimal point shall be between them. The value for the gravity vector shall be $980.00000 \pm 05.00000 \text{ cm/sec}^2$.

6.2.6.2.6 Enter VERB 33 into K148. Press the ENTER pushbutton.

6.2.6.2.7 When VERB 06 NOUN 66 flashes the value of the horizontal earth rate shall be displayed in R1 and R2 on the CRT. Record these values.

6.2.6.2.8 R1 contains the first five digits of earth rate and R2 contains the last five digits. A decimal point shall be placed between them. R1 shall always to 00000. The horizontal earth rate shall be $00000.65000 \pm 0.1000 \text{ earth rate units}$.

6.2.6.3 Test Termination

6.2.6.3.1 Enter VZFP 36 into K148. Press the ENTER pushbutton.

6.2.6.3.2 Enter VERB 41, NOUN 20 into K148. Press the ENTER pushbutton.

6.2.6.3.3 Enter +00000 into K148 three times. Press the ENTER pushbutton after each entry.

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6.2.7 Gimbal Friction Test

6.2.7.1 Proceed with this test if 6.2.5.2 or 6.2.3 has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 before proceeding with this test.

6.2.7.2 Inner Gimbal Friction Test

6.2.7.2.1 Enter the following sequence into the K-Start, pushing the ENTER pushbutton after each entry:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.7.2.2 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

- a. CG 2120 IG TORQUE MOTOR CURRENT
- b. CG 2117 IGA SERVO ERROR IN PHASE
- c. CG 2112 IG 1X RESOLVER OUTPUT SIN
- d. CG 2113 IG 1X RESOLVER OUTPUT COS
- e. CG 2220 IGA CDU FINE ERROR
- f. CG 1201 IMU 28 V 0.8KC 1 pct 0 Deg
- g. CG 2300 PIPA TEMPERATURE
- h. CG 2301 INIG TEMPERATURE

6.2.7.2.3 Enter the following sequence into the K-Start, pushing the ENTER pushbutton after each entry (+360 IG torquing)

- a. VERB 24 NOUN 01, ENTER
- b. 00407, ENTER
- c. 40000, ENTER
- d. 40034, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.2.4 Enter the following sequence into K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (verify VERB 33 on CRT)

6.2.7.2.5 Start analog recorders.

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- 6.2.7.2.6 Observe measurement CG 2112, IG LX Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.
- 6.2.7.2.7 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.
- a. VERB 40, NOUN 20, press ENTER
 - b. VERB 41, NOUN 20, press ENTER
 - c. +00000, press ENTER
 - d. +00000, press ENTER
 - e. +00000, press ENTER
- 6.2.7.2.8 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 60 seconds before proceeding.
- 6.2.7.2.9 Enter the following sequence into the K-Start. Push the ENTER push button after each entry (=360° IG torquing):
- a. VERB 24 NOUN 01 ENTER
 - b. 00407, ENTER
 - c. 37777, ENTER
 - d. 37743, ENTER
- Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.
- 6.2.7.2.10 Enter the following sequence into K-Start:
- a. VERB 42, press ENTER
 - b. VERB 33, press ENTER (Verify VERB 33 on CRT).
- 6.2.7.2.11 Start analog recorders.
- 6.2.7.2.12 Observe measurement CG 2112, IG LX Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.
- 6.2.7.2.13 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.
- a. VERB 40, NOUN 20, press ENTER
 - b. VERB 41, NOUN 20, press ENTER
 - c. +00000, press ENTER
 - d. +00000, press ENTER
 - e. +00000, press ENTER
- 6.2.7.2.14 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 60 seconds before proceeding.

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- 6.2.7.3 Outer Gimbal Friction Test
- 6.2.7.3.1 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):
- a. CG 2180 OG TORQUE MOTOR CURRENT
 - b. CG 2177 OGA SERVO ERROR IN PHASE
 - c. CG 2172 OG LX RESOLVER OUTPUT SIN
 - d. CG 2173 OG LX RESOLVER OUTPUT COS
 - e. CG 2280 OGA CDU FINE ERROR
 - f. CG 1201 IMU 26 V 0.8 KC 1 PCT 0 DEG RMS
 - g. CG 2300 PIPA TEMPERATURE
 - h. CG 2301 IRIG TEMPERATURE
- 6.2.7.3.2 Enter the following sequence into the K-Start. Pushing the ENTER pushbutton after each entry (+360° OG torquing):
- a. VERB 24 NOUN 01, ENTER
 - b. 00405, ENTER
 - c. 40000, ENTER
 - d. 40034, ENTER
- Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.
- 6.2.7.3.3 Enter the following sequence into K-Start:
- a. VERB 42, press ENTER
 - b. VERB 33, press ENTER (Verify VERB 33 on CRT)
- 6.2.7.3.4 Start analog recorders
- 6.2.7.3.5 Observe measurement CG 2172, OG LX Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.
- 6.2.7.3.6 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.
- a. VERB 40, NOUN 20, press ENTER
 - b. VERB 41, NOUN 20, press ENTER
 - c. +00000, press ENTER
 - d. +00000, press ENTER
 - e. +00000, press ENTER
- 6.2.7.3.7 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 60 seconds before proceeding.

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6.2.7.3.8 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (=360° OG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00405, ENTER
- c. 37777, ENTER
- d. 37743, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.3.9 Enter the following sequence into K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (verify VERB 33 on CRT).

6.2.7.3.10 Start analog recorders.

6.2.7.3.11 Observe measurement CG 2172, CG 1X resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorder.

6.2.7.3.12 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 40, NOUN 20, press ENTER
- b. VERB 41, NOUN 20, press ENTER
- c. +00000, press ENTER
- d. +00000, press ENTER
- e. -06750, press ENTER

6.2.7.3.13 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = -06750, Wait 60 seconds before proceeding.

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6.2.7.4 Middle Gimbal Friction Test

6.2.7.4.1 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

- a. CG 2150 MG TORQUE MOTOR CURRENT
- b. CG 2147 MGA SERVO ERROR IN PHASE
- c. CG 2142 MG 1X RESOLVER OUTPUT SIN
- d. CG 2143 MG 1X RESOLVER OUTPUT COS
- e. CG 2250 MGA CDU FINE ERROR
- f. CG 2101 IMU 28V, 0.8 KC 1 PCT 0 DEG RMS
- g. CG 2300 PIPA TEMPERATURE
- h. CG 2301 IIRIG TEMPERATURE

6.2.7.4.2 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (+135° MG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00411, ENTER
- c. 63777, ENTER
- d. 77777, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.4.3 Enter the following sequence in the K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.4.4 Start the analog recorder.

6.2.7.4.5 Observe measurement CG 2142, MG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 5 minutes), stop the recorders.

6.2.7.4.6 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 40 NOUN 01, ENTER
- b. VERB 41 NOUN 20, press ENTER
- c. +00000, press ENTER
- d. +00000, press ENTER
- e. +06750, press ENTER

6.2.7.4.8 Enter the following sequence into the K-Start. Push ENTER push-button after each entry (-135° MG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00411, ENTER
- c. 14000, ENTER
- d. 00000, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

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6.2.7.4.9 Enter the following sequence in the K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.4.10 Start analog recorders.

6.2.7.4.11 Observe measurement CG 2143, M3 LX Resolver output SIN, on the analog recorder. When the steady-state condition occurs, with the reading near zero (approximately 5 minutes), stop the recorders.

6.2.7.4.12 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 40 NOUN 20, press ENTER
- b. VERB 41 NOUN 20, press ENTER
- c. +00000, press ENTER
- d. +00000, press ENTER
- e. +00000, press ENTER

4.2.7.5 Examine the traces of the recorded measurements for all six phases of this test to detect any sharp discontinuities. Disregard transients of 0.5 second duration or less on the Gimbal Torque motor current traces, and those less than 0.2 second on the CDU fine error measurement traces. The Gimbal Torque motor currents shall not exceed 0.125 ampere.

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- 6.2.8 G&N Panel Brightness and Lamp Test
- 6.2.8.1 Proceed with this test if 6.2.5.2 or 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 before proceeding with this test.
- 6.2.8.2 Rotate the RETICLE BRIGHTNESS thumbwheel on the Control Indicator Panel and verify the capability to control the illumination of the following lamps:
- a. SCT reticles
 - b. SXT reticles
 - c. Telescope Panel Angle Counters
- 6.2.8.3 Turn on LIGHTS-INTEGRAL control on Left Hand Circuit Breaker panel and LEB Lighting Control Panel.
- 6.2.8.4 Adjust the brightness controls on the LEB Lighting Control Panel and Left Hand Circuit Breaker Panel from minimum brightness to maximum brightness. Verify the operation of the G&N Indicator Control Panel lamps.
- 6.2.8.4.1 Re-adjust brightness controls for minimum acceptable lighting. Turn off LIGHTS-INTEGRAL control on Left Hand Circuit Breaker panel and LEB Lighting Control Panel.
- 6.2.8.5 Push and hold the CONDITION LAMPS switch on the G&N Indicator Control Panel to TEST. Verify the illumination of the following lamps:
- a. STAR ACQ
 - b. MASTER ALARM lamp
- 6.2.8.6 Set the CONDITION LAMPS switch to ON. Lamps a and b in 6.2.8.5. shall extinguish.

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6.2.9 Semi-Automatic Moding Check

Proceed with this test if 6.2.2.2 or 6.2.4 has been completed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.2.2 before proceeding with this test.

6.2.9.1 Test Initiation

6.2.9.1.1 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG1530) is +28.0±3.0 VDC. Record the indication on the CRT. Verify that OPTX 28V 800 cps 1% oph (CG1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.

6.2.9.1.2 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.9.1.3 Enter 00010 into K148. Press the ENTER pushbutton.

6.2.9.1.4 Observe VERB 33 NOUN 01 flashes on the CRT and the PROGRAM display indicates 07.

6.2.9.2 Enter VERB 33 and press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

- a. VERB 33 NOUN 02 flashing
- b. R1 = +00000 ± 00003
- c. R2 = +00000 ± 00003
- d. R3 = +00000 ± 00003
- e. IG angle = 000 ± 1 deg.
- f. MG angle = 000 ± 1 deg.
- g. OG angle = 000 ± 1 deg.

6.2.9.3 Enter VERB 33 and press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

- a. VERB 33 NOUN 03 flashing
- b. R1 = +04500 ± 00003
- c. R2 = +04500 ± 00003
- d. R3 = +04500 ± 00003
- e. IG angle = 045 ± 1 deg.
- f. MG angle = 045 ± 1 deg.
- g. OG angle = 045 ± 1 deg.

6.2.9.4 Enter VERB 33 and press the ENTER pushbutton. After approximately 100 seconds the following data shall be displayed on the CRT.

- a. VERB 05 NOUN 30 flashing
- b. R1 = 00000 ± 00003
- c. R2 = 00000 ± 00003
- d. R3 = 00000 ± 00003

NOTE: Negative numbers will be displayed in octal complement form, i.e., -00001 = 77776.

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6.2.9.5 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 33 NOUN 05 flashing
- b. $R1 = +07100 \pm 00003$
- c. $R2 = +07100 \pm 00003$
- d. $R3 = +07100 \pm 00003$
- e. IG angle = 071 ± 1 deg.
- f. MG angle = 071 ± 1 deg.
- g. OG angle = 071 ± 1 deg.

The GIMBAL LOCK lamps on the DSKY's shall light.

6.2.9.6 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 33 NOUN 06 flashing
- b. $R1 = +09000 \pm 00003$
- c. $R2 = +09000 \pm 00003$
- d. $R3 = +09000 \pm 00003$
- e. IG angle = 090 ± 1 deg.
- f. MG angle = 090 ± 1 deg.
- g. OG angle = 090 ± 1 deg.

6.2.9.7 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 33 NOUN 07
- b. $R1 = +13500 \pm 00003$
- c. $R2 = +13500 \pm 00003$
- d. $R3 = +13500 \pm 00003$
- e. IG angle = 135 ± 1 deg.
- f. MG angle = 135 ± 1 deg.
- g. OG angle = 135 ± 1 deg.

6.2.9.8 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds VERB 33 NOUN 10 shall flash. The GIMBAL LOCK lamp shall extinguish on the DSKY's.

6.2.9.9 Enter VERB 33 and press the ENTER pushbutton. After approximately 100 seconds the following data shall be displayed on the CRT.

- a. VERB 05 NOUN 30 flashing
- b. $R1 = 00000 \pm 00003$
- c. $R2 = 00000 \pm 00003$
- d. $R3 = 00000 \pm 00003$

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6.2.9.10 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 33 NOUN 12 flashing
- b. $R1 = +22500 \pm 00003$
- c. $R2 = +22500 \pm 00003$
- d. $R3 = +22500 \pm 00003$
- e. IG angle = 225 ± 1 deg.
- f. MG angle = 225 ± 1 deg.
- g. OG angle = 225 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY's shall light.

6.2.9.11 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 33 NOUN 13 flashing
- b. $R1 = +22500 \pm 00003$
- c. $R2 = +22500 \pm 00003$
- d. $R3 = +31500 \pm 00003$
- e. IG angle = 225 ± 1 deg.
- f. OG angle = 225 ± 1 deg.
- g. MG angle = 315 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY shall extinguish.

6.2.9.12 Enter VERB 33 and press the ENTER pushbutton. After approximately 100 seconds the following data shall be displayed on the CRT.

- a. VERB 05 NOUN 30 flashing
- b. $R1 = 00000 \pm 00003$
- c. $R2 = 00000 \pm 00003$
- d. $R3 = 00000 \pm 00003$

6.2.9.13 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 33 NOUN 15 flashing
- b. $R1 = +31500 \pm 00003$
- c. $R2 = +31500 \pm 00003$
- d. $R3 = +31500 \pm 00003$
- e. IG angle = 315 ± 1 deg.
- f. MG angle = 315 ± 1 deg.
- g. OG angle = 315 ± 1 deg.

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6.2.9.14 Enter VERB 33 and press the ENTER pushbutton. After approximately 100 seconds the following data shall be displayed on the CRT.

- a. VERB 05 NOUN 30 flashing
- b. R1 = 00000 ± 00003
- c. R2 = 00000 ± 00003
- d. R3 = 00000 ± 00003

6.2.9.15 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 33 NOUN 17 flashing
- b. R1 = +31500 ± 00003
- c. R2 = +31500 ± 00003
- d. R3 = +28900 ± 00003
- e. IG angle = 315 ± 1 deg.
- f. OG angle = 315 ± 1 deg.
- g. MG angle = 289 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY's shall light.

6.2.9.16 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data will be displayed on the CRT.

- a. VERB 33 NOUN 20 flashing
- b. R1 = +00000 ± 00003
- c. R2 = +00000 ± 00003
- d. R3 = +00000 ± 00003
- e. IG angle = 000 ± 1 deg.
- f. MG angle = 000 ± 1 deg.
- g. OG angle = 000 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY's shall extinguish.

6.2.9.17 Enter VERB 33 and press the ENTER pushbutton. After approximately 15 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 66 flashing
- b. R1 = 000xx
- c. R2 = xxxxx

The GIMBAL LOCK lamp on the DSKY's shall light.

Record R1 and R2 as the Middle Gimbal CDU drive rate.

MG rate = $\frac{R1}{14}$, $\frac{R2}{14}$ */sec. The Middle Gimbal CDU drive rate shall be 14 ± 2°/sec.

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6.2.9.18 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 66 flashing
- b. R1 = 000xx
- c. R2 = xxxxx

The GIMBAL LOCK lamp on the DSKY's shall extinguish.

Record R1 and R2 as the Inner Gimbal CDU drive rate.
IG rate = $\frac{R1}{14} \cdot \frac{R2}{20}$ /sec. The Inner Gimbal CDU drive rate shall be 14 ± 20 /sec.

6.2.9.19 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 66 flashing
- b. R1 = 000xx
- c. R2 = xxxxx

Record R1 and R2 as the Outer Gimbal CDU drive rate.
OG rate = $\frac{R1}{14} \cdot \frac{R2}{20}$. The Outer Gimbal CDU drive rate shall be 14 ± 20 /sec.

6.2.9.20 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds VERB 21 NOUN 22 shall flash on the CRT. Enter +00100 into K148 three times. Press the ENTER pushbutton after each entry. After approximately 100 seconds VERB 01 NOUN 10 flashing shall be displayed on the CRT. Press the ENTER pushbutton.

Enter 00030 into K148. Press the ENTER pushbutton. Verify R1 = 33xxx.

The ISS WARNING Lamp on the Indicator Control Panel shall light.
The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be ON.

6.2.9.21 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds VERB 21 NOUN 22 shall flash on the CRT. Enter +03375 into K148 three times. Press the ENTER pushbutton after each entry. After approximately 100 seconds VERB 01 NOUN 10 flashing shall be displayed on the CRT. Press the ENTER pushbutton.

Enter 00030 into K148. Press the ENTER pushbutton.
Verify R1 = 33xxx.

The ISS WARNING lamp on the Indicator Control Panel shall light.
The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be ON.

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- 6.2.9.22 Enter VERB 33 into K148. Press the ENTER pushbutton. VERB 33 NOUN 55 shall flash on the CRT. The ISS WARNING lamp on the Control Indicator Panel shall extinguish. The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be OFF.
- 6.2.9.23 Set the OPTICS MODE switch on the Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to CMC.
- 6.2.9.24 Press the ENTER pushbutton. After approximately 25 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 66 flashing
 - b. R1 = 000xx
 - c. R2 = xxxxx
- Record R1 and R2 as the Shaft Optics CDU drive rate.
Shaft rate = $\frac{R1}{R2}$. The Shaft Optics CDU drive rate shall be 7.32 ± 1.82 /sec.
- 6.2.9.25 Enter VERB 33 into K148. Press the ENTER pushbutton. In about 15 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 66
 - b. R1 = 0000x
 - c. R2 = xxxxx
- Record R1 and R2 as the Trunnion Optics CDU drive rate. Trunnion rate = $\frac{R1}{R2}$. The Trunnion Optics CDU drive rate shall be 1.83 ± 0.50 /sec.
- 6.2.9.26 Terminate the Semi-Automatic Moding Check by entering VERB 34 into K148. Press the ENTER pushbutton. Set the G&N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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6.2.10 Zero Optics Test

NOTE: Proceed with this test if 6.2.4 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.2.2 Turn On procedure before proceeding.

- 6.2.10.1 Set the G/N POWER - OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $+28.0 \pm 3.0$ VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.
- 6.2.10.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.
 - a. VERB 41, NOUN 20, ENTER
 - b. +00000, ENTER
 - c. +00000, ENTER
 - d. +00000, ENTER
- 6.2.10.3 Insure that the following switches on the G&N Indicator Control Panel are set as follows:
 - a. TELESCOPE TRUNNION to SLAVE TO SXT
 - b. CONTROLLER COUPLING to DIRECT
 - c. CONTROLLER SPEED to HI
- 6.2.10.4 Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K148. Press the ENTER pushbutton.
- 6.2.10.5 Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following on R1 and R2 of the CRT.
 - a. $R1 = +000.00 \pm 000.03$ (Shaft Angle)
 - b. $R2 = +00.000 \pm 00.006$ (Trunnion LOS Angle)

Return the OPTICS MODE switch to MAN.
- 6.2.10.6 Set up the Analog Recorder to monitor the following measurements. Use a chart speed of 10 mm/sec.
 - a. CG 3140 SXT Shaft Tach Output
 - b. CG 3145 SXT Shaft Motor Control Winding
 - c. CG 3150 SXT Trunnion Tach Output
 - d. CG 3155 SXT Trunnion Motor Control Winding
 - e. CG 3160 SCT Shaft Tach Output
 - f. CG 3170 SCT Trunnion Tach Output

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- 6.2.10.7 Push the Optics Hand Controller to the right, driving the SXT Shaft until R1 on the CRT indicates +180.00. Push the Optics Hand Controller up, driving the SXT Trunnion until R2 on the CRT indicates +75.000.
- 6.2.10.8 Start the Analog Recorders and set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.
- 6.2.10.9 Monitor the Analog Recorders until all signals return to null. Stop the Analog Recorders. The elapsed time between the initial and final SXT Tach output null shall be less than 15 seconds.
- 6.2.10.10 Record R1 and R2 on the CRT. The data displayed shall be as follows:
- a. $R1 = 000.00 \pm 000.03$
 - b. $R2 = 00.000 \pm 00.000$
- 6.2.10.11 Record the Telescope Panel Angle Counter indications. The Shaft Angle shall be 0.0 ± 0.1 degrees. The Trunnion Angle shall be 0.0 ± 0.2 degrees.
- 6.2.10.12 Set the OPTICS MODE switch on the G&N Indicator Control Panel to MAN.

NOTE: If optics testing will not be continued, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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6.2.11 OPTICS Coordinate Transformation Control Test

NOTE: Proceed with this test if 6.2.3 Operate Power on Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding.

- 6.2.11.1 Set/verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $+28.0 \pm 3$ VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28 V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.
- 6.2.11.2 Enter the following into the K-Start. Press the ENTER pushbutton after each entry:
- a. VERB 41 NOUN 20, ENTER
 - b. +00000, ENTER
 - c. +00000, ENTER
 - d. +00000, ENTER
- 6.2.11.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the position indicated.
- a. TELESCOPE TRUNNION to SLAVE TO SXT
 - b. CONTROLLER COUPLING to DIRECT
 - c. CONTROLLER SPEED to HI
- 6.2.11.4 Enter the following into the K-Start to monitor the OPTICS CDU's
VERB 16 NOUN 55, press ENTER
- 6.2.11.5 Set the OPTICS MODE switch on the G&N Panel to ZERO. Wait 15 seconds. Insure that the Optics zero properly by observing that R1 and R2 of the CRT indicate as follows:
- a. $R1 = +000.00 \pm 000.03$ (Shaft Angle)
 - b. $R2 = +00.000 \pm 000.06$ (Trunnion LOS Angle)
- Return the OPTICS MODE switch to MAN.
- 6.2.11.6 Set up the analog recorders to monitor the following measurements:
- a. CG 3160 SCT Shaft Tachometer Output
 - b. CG 3170 SCT Trunnion Tachometer Output
- 6.2.11.7 Using the OPTICS CONTROL STICK, drive the Optics until $R1 = 225.00$ and $R2 = 10.000$ on the CRT and the DSKY's.
- 6.2.11.8 Set the CONTROLLER COUPLING switch on the G&N Panel to RSLV and the controller speed switch to MED.

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- 6.2.11.9 Position the movable optics target such that it is centered on the SCT retical pattern, then start the analog recorders at a chart speed of 10 mm/second.
- 6.2.11.10 Quickly displace the OPTICS CONTROL STICK 45 ± 10 degrees in the upper right hand quadrant while sighting on the optics target through the SCT eyepiece. The target shall appear to move in the upper right field of view of the SCT at 45 ± 10 deg. Release the control stick when the target leaves the SCT upper right field of view, and immediately record the shaft angle as displayed on RI of the CRT and DSKY's. The recorded shaft angle shall be $+225 \pm 10.00$ degrees.
- 6.2.11.11 Step the analog recorder and measure the elapsed time between the initial and the final signal null conditions for the two measurements. The elapsed time shall be 24 ± 6 seconds.
- 6.2.11.12 Set the CONTROLLER COUPLING switch on the G&N Panel to DIRECT and drive the Optics with the OPTICS CONTROL STICK until the shaft and trunnion angles as indicated on the SCT TPAC's are approximately zero, then repeat step 6.2.11.5.

NOTE: If Optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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6.2.12

Optics Positional Accuracy Test. Proceed with this test if 6.2.3 Operate Power On Test, or 6.2.5.2, Turn-On Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2, Turn On Procedure, before proceeding.

NOTE: This test requires the use of the G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT StLOS before proceeding. Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.

6.2.12.1

Set/verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify the following:

- +28 VDC OPTX OPERATE BUS (CG 1530) is 28.8 ± 3 VDC. Record the indication on the CRT.
- CG 1211 OPTX 28V 800 cps 1% 0 ph not flashing on CRT.
- CG 1212 OPTX 800 cps 5% - 90 ph not flashing on CRT.

6.2.12.2

Enter the following sequence into the K-Start.

- VERB 41, NOUN 20, ENTER
- +00000, ENTER
- +00000, ENTER
- +00000, ENTER

6.2.12.3

Insure that OPTICS Optics control switches on the G&N Indicator Control Panel are set as follows:

- OPTICS MODE TO MAN
- CONTROLLER SPEED to LO
- CONTROLLER COUPLING to DIRECT
- TELESCOPE TRUNNION to SLAVE TO SXT

6.2.12.4

Set the OPTICS MODE switch to ZERO. After 20 seconds return the switch to MAN.

6.2.12.5

Resolution Checks

6.2.12.5.1

Sight through the SXT eyepiece. Using the OPTIC CONTROL STICK, adjust the SXT to obtain the best reflected field of view of the 5-inch autocollimator reticle engravings at the center of the field of view.

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- 6.2.12.5.2 Note that the autocollimator reticle contains a series of lines of different thickness and width. Each set of lines is marked with a number (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines. The SXT resolution shall be at least 10 arc-seconds at the center of the field of view.
- 6.2.12.5.3 Repeat 6.2.12.5.1 and 6.2.12.5.2 using the SCT and the SCT resolution chart. The SCT shall have a resolution of at least 3 arc-minutes at the center of the field of view.
- 6.2.12.6 Slave Telescope Mode Checks
- 6.2.12.6.1 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.6.2 Set the OPTICS MODE switch on the Control Indicator Panel to ZERO. After 20 seconds return the OPTICS MODE switch to MAN.
- 6.2.12.6.3 Record the SCT Shaft and Trunnion angles as indicated by the TPAC and the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between the TPAC Shaft angle and the Shaft CDU angle shall be $\pm 0.11^\circ$ or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be $\pm 0.22^\circ$ or less.
- 6.2.12.6.4 Using the OPTICS CONTROL STICK and CONTROLLER SPEED switch, drive the SXT Shaft and Trunnion CDU's until R1 = $+035.00^\circ$ deg. and R2 = $+35.000^\circ$ deg. Record R1 and R2. Record the Shaft and Trunnion angles as indicated by the TPAC. The difference between the TPAC Shaft angle and Shaft CDU angle shall be $\pm 0.11^\circ$ or less. The difference between the TPAC Trunnion angle and Trunnion CDU angle shall be $\pm 0.22^\circ$ or less.
- 6.2.12.6.5 Set the OPTICS MODE switch to ZERO. After 20 seconds return the OPTICS MODE switch to MAN.
- 6.2.12.6.6 Set the TELESCOPE TRUNNION switch to the 0° position.

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- 6.2.12.6.7 Remove the plug from the base of the SXT eyepiece and install the Adapter Assembly and Portable Light Assembly. Turn on the light.
NOTE: If needed to reduce external light, place a photographers hood over the optics head and retroreflecting prism.
- 6.2.12.6.8 By sighting through the SCT eyepiece, position the Retroreflecting Prism, Model No. A23-200, to span between the SXT StLOS and SCT LOS such that the illumination from the backlight filament is clearly visible at the center of the field of view.
- 6.2.12.6.9 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Using the OPTICS CONTROL STICK, adjust the trunnion CDU to bring the SCT horizontal reticle line into coincidence with the SXT horizontal reticle line. Record the Trunnion CDU angle displayed in R2 as XX.XXX degrees. The difference between this angle and the corresponding angle recorded in 6.2.12.6.3 shall be $\pm 0.2^\circ$ or less.
- 6.2.12.6.10 Replace the Portable Light in the adapter on the SXT eyepiece.
- 6.2.12.6.11 Set the OPTICS MODE switch to ZERO. After 20 seconds return the OPTICS MODE switch to MAN. Set the TELESCOPE TRUNNION switch to SLAVE TO SXT.
- 6.2.12.6.12 Temporarily disable the SCT TRUNNION electrical drive by carefully unscrewing the SCT TRUNNION Manual Drive until it just releases from the panel. Do not rotate further, as this would displace the SCT LOS from the desired reference position.
- 6.2.12.6.13 Remove the Portable Light from the adapter and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in step 6.2.12.6.9. Again using the OPTICS CONTROL STICK, bring the SCT horizontal reticle line into coincidence with the SXT horizontal reticle. Record the Trunnion CDU angle displayed in R2. The difference between this angle and the corresponding angle measured in 6.2.12.6.3 shall be $\pm 0.2^\circ$ or less. Replace the Portable Light Assembly in the adapter.
- 6.2.12.6.14 Replace the SCT TRUNNION Manual Drive in the panel.
- 6.2.12.6.15 Use the OPTICS CONTROL STICK to drive the Trunnion CDU to $+25.000^\circ \pm 0.005^\circ$ as indicated on R2. Maintain the Shaft CDU at $000.00^\circ \pm 0.01^\circ$ as indicated on R1.
- 6.2.12.6.16 Set the TELESCOPE TRUNNION switch to 25° . After 30 seconds has elapsed, record the TPAC Trunnion angle and Trunnion CDU angle displayed in R2. The difference shall be $\pm 0.22^\circ$ or less. Record the Shaft CDU angle displayed in R1.
- 6.2.12.6.17 Temporarily disable the electrical drive to the SCT Trunnion and SCT Shaft by unscrewing the SCT Trunnion and Shaft Manual Drive items until they just release from the panel. Do not rotate further, as this would displace the SCT LOS from the desired reference position.

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6.2.12.6.18	Reposition the Retroreflecting Prism so that it is inclined at an angle of 25° downward and spans the SCT LOS and SXT StLOS. Sight into the SCT and adjust the prism so that illumination from the backlight filament is again visible at the center of the field of view. Remove the Portable Light Assembly from the SXT eyepiece adapter and direct the light into the SCT eyepiece while sighting through the SXT eyepiece. Observe the comparison of SCT and SXT reticles. Adjust the Trunnion CDU and Shaft CDU angles with the OPTICS CONTROL STICK to bring the two reticle patterns into coincidence. Record the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between each of these angles and the respective angles recorded in 6.2.12.6.16 shall be ± 0.2 degrees or less.						
6.2.12.6.19	Replace the SCT Shaft and Trunnion Manual Drive items. Replace the Portable Light Assembly in the adapter. Set the TELESCOPE TRUNNION switch to SLAVE TO SXT. Set the OPTICS MODE switch to ZERO. Wait 20 seconds and then set the OPTICS MODE to MAN. Remove the Retro-reflecting Prism and photographer's hood if used.						
6.2.12.7	SXT Parallelism Tests						
6.2.12.7.1	Using the OPTICS CONTROL STICK drive the SXT StLOS Trunnion to $+15.000^\circ \pm 2^\circ$ as indicated in R2 of the DSKY. Maintain a Shaft CDU angle of 000.00 ± 0.01 degrees.						
6.2.12.7.2	Sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to superimpose the SXT LLOS horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.						
6.2.12.7.3	Repeat 6.2.12.7.2 twice. Calculate and record the average of the three autocollimator readings.						
6.2.12.7.4	Set the OPTICS MODE switch to ZERO. After 20 seconds return the OPTICS MODE switch to MAN.						
6.2.12.7.5	Again sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to bring the SXT StLOS horizontal reticle and autocollimator horizontal filar images to coincide. Record the autocollimator reading.						
6.2.12.7.6	Repeat 6.2.12.7.5 twice. Calculate and record the average of the three autocollimator readings. The average value obtained here shall not differ from that obtained in 6.2.12.7.3 by more than 10 arc seconds.						
6.2.12.7.7	Using the OPTICS CONTROL STICK drive the SXT Trunnion angle to $85.000^\circ \pm 5^\circ$ as indicated on R2 of the DSKY. Set the CONTROLLER SPEED to LO and drive the SXT Trunnion to $+90.000^\circ \pm 0.006^\circ$ as indicated on R2 of the DSKY. Insure that the SXT Shaft angle remains at 000.00 ± 0.02 degrees as indicated by R1 on the DSKY.						
6.2.12.7.8	Sight through the SXT. Two reticle patterns shall be visible. Use the OPTICS CONTROL STICK to adjust the SXT Trunnion angle until the two horizontal reticle lines are coincident. Record the Trunnion CDU angle displayed in R2. The Trunnion CDU angle shall be 90.000 ± 0.010 degrees.						

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- 6.2.12.7.9 Remove the Portable Light Assembly and Adapter Assembly from the base of the SXT eyepiece. Replace the SXT eyepiece plug.
NOTE: If Optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.
- 6.2.12.8 Shaft and Trunnion Positional Accuracy Checks.
- 6.2.12.8.1 Set the OPTICS MODE switch to ZERO. After 30 seconds, return the selector to MANUAL.
- 6.2.12.8.2 Sight through the SXT. Using the control stick align the SXT SLOS with optical target No. 1 on the G&N Installation Fixture Model No. A23-071.
- 6.2.12.8.3 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton. Record the value of R1 and R2 displayed on the CRT. Record the Shaft and Trunnion Angles from the TPAC.
- 6.2.12.8.4 Sight through the SXT. Using the control stick align the SXT SLOS with Optical Target No. 2 on A23-071.
- 6.2.12.8.5 Record the value in R1 and R2 on the CRT. Record the Shaft and Trunnion Angles from the TPAC.
- 6.2.12.8.6 Set the OPTICS MODE switch to ZERO. After 30 seconds set the switch to CMC.
- 6.2.12.8.7 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.8 Enter the value recorded from R1 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.9 Enter the value recorded from R2 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.10 Sight through the SXT. The SLOS should be centered on Optical Target No. 1 on A23-071. Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.3 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.11 Enter VERB 41 NOUN 55 into the K-START. Press the ENTER pushbutton.
- 6.2.12.8.12 Enter the value recorded from R1 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.13 Enter the value recorded from R2 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.

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SPACE and INFORMATION SYSTEMS DIVISION
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APOLLO G&N Specification
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- 6.2.12.8.14 Sight through the SXT. The SLOS should be centered on Optical Target No. 2 on A23-071. Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.5 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.15 Set the OPTICS MODE switch to ZERO. After 30 seconds return the switch to MANUAL.
- 6.2.12.8.16 Enter VERB 41 NOUN 20 into the K-START. Press the ENTER pushbutton. Enter +00000 into the K-START 3 times. Press the ENTER pushbutton after each entry.

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6.2.13 Optics Slew Rate Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On procedure, before proceeding.

6.2.13.1 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $\pm 28.0 \pm 3.0$ VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.

6.2.13.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.

- VERB 41 NOUN 20, ENTER
- +00000, ENTER
- +00000, ENTER
- +00000, ENTER

6.2.13.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the positions indicated.

- TELESCOPE TRUNNION to SLAVE to SXT
- CONTROLLER COUPLING to DIRECT
- CONTROLLER SPEED to HI

6.2.13.4 Monitor the OCDU's by entering VERB 16 NOUN 55 into K148. Press the ENTER pushbutton.

6.2.13.5 Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following data displayed in R1 and R2 on the DSKY.

- R1 = $\pm 000.00 \pm 000.03$ (Shaft Angle)
- R2 = $\pm 00.000 \pm 00.006$ (Trunnion LOS Angle)

Set the OPTICS MODE switch on the G&N Indicator Panel to MAN.

NOTE: Read & understand step 6.2.13.6 before proceeding. Do not hold Control Stick at upper limit more than 10 seconds.

Trunnion Slew Rate - HI Speed

6.2.13.6 Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 5 seconds after the first mark, again press the MARK pushbutton and record the new display in R2 and R3. The data displayed is in the following form:

- R2 = $\pm XX.XXX$ (Trunnion LOS angle in deg.)
- R3 = $\pm XXX.XX$ (Time in seconds)

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6.2.13.7 Perform the following calculations:

- a. Difference between R2 displays = (Δ trun. angle)
 b. Difference between R3 displays = (Δ time)
 c.
- $$\frac{\Delta \text{ trun. angle}}{\Delta \text{ time}} = \text{ deg/sec}$$

The Trunnion slew rate shall be 9.0 ± 1.8 deg/sec.

Shaft Slew Rate - HI Speed

6.2.13.8 Using the Optics Control Stick, drive the Trunnion LOS Angle back to approximately zero degrees as indicated on the TPAC. Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read and understand step 6.2.13.9 before proceeding. Do not hold for more than 10 seconds.

6.2.13.9 Push and hold the Optics Control stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 5 seconds after the first mark, again press the MARK pushbutton and record the new display in R1 and R3. The data displayed is in the following form.

- R1 = + XXX.XX (Shaft angle in deg.)
 R3 = + XXX.XX (Time in seconds)

6.2.13.10 Perform the following calculations

- a. Difference between R1 displays = (Δ shaft angle)
 b. Difference between R3 displays = (Δ time)
 c.
- $$\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \text{ deg/sec}$$

The Shaft Slew Rate shall be 17.6 ± 3.5 deg/sec.

Trunnion Slew Rate - MED Speed

6.2.13.11 Using the Optics Control Stick, drive the shaft angle back to approximately zero degrees as indicated on the TPAC. Set the OPTICS MODE switch to zero. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to MED.

NOTE: Read & understand 6.2.13.12 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

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6.2.13.12 Push and hold the Optics Control stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 10 seconds after the first mark, again press the MARK pushbutton and record the new display in R2 & R3. The data displayed is in the following form:

- a. R2 = XX.XXX (Trunnion LOS Angle in degrees)
- b. R3 = XXX.XX (Time in seconds)

6.2.13.13 Perform the following calculations:

- a. Difference between R2 displays = ____ . ____ (Δ Trunnion Angle)
- b. Difference between R3 displays = ____ . ____ (Δ Time)

$$\frac{\Delta \text{ Trunnion angle}}{\Delta \text{ Time}} = _ . _ _ \text{ deg./sec}$$

The Trunnion slew rate shall be $0.90 \pm 0.18 \text{ deg./sec.}$

Shaft Slew Rate - MED Speed

6.2.13.14 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read & understand 6.2.13.15 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.15 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 10 seconds after the first mark, again press the MARK pushbutton and record the new display in R1 and R3. The data displayed is in the following form:

- a. R1 = ± XXX.XX (Shaft Angle in degrees)
- b. R3 = ± XXX.XX (Time in seconds)

6.2.13.16 Perform the following calculations

- a. Difference between R1 displays = ____ . ____ (Δ Shaft Angle)
- b. Difference between R3 displays = ____ . ____ (Δ Time)

$$\frac{\Delta \text{ Shaft Angle}}{\Delta \text{ Time}} = _ . _ _ \text{ deg/sec}$$

The Shaft Slew Rate shall be $1.80 \pm 0.36 \text{ deg/sec.}$

Trunnion Slew Rate - LO Speed

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6.2.13.17 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to LO.

NOTE: Read and understand 6.2.13.18 before proceeding. Do not hold control stick at upper limit for more than 30 seconds.

6.2.13.18 Push and hold the Optics Control stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 10 seconds after the first mark, again press the MARK pushbutton and record the new display in R2 and R3. The data displayed is in the following form:

- a. R2 = XX.XXX (Trunnion LOS Angle in degrees)
- b. R3 = XXX.XX (Time in seconds)

6.2.13.19 Perform the following calculations

- a. Difference between R2 displays = XX.XXX (Δ Trunnion Angle)
- b. Difference between R3 displays = XXX.XX (Δ Time)
- c.
$$\frac{\Delta \text{ Trunnion Angle}}{\Delta \text{ Time}} = \text{---} \text{ deg/sec}$$

The Trunnion Slew Rate shall be 0.10 ± 0.02 deg/sec.

Shaft Slew Rate - LO Speed

6.2.13.20 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read and understand 6.2.13.21 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.21 Push and hold the Optics Control stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 10 seconds after the first mark, again press the MARK pushbutton and record the new display in R1 and R3. The data displayed is in the following form:

- a. R1 = XXX.XX (Shaft Angle in degrees)
- b. R3 = XXX.XX (Time in seconds)

6.2.13.22 Perform the following calculations:

- a. Difference between R1 displays = --- . --- (Δ Shaft Angle)
- b. Difference between R3 displays = --- . --- (Δ Time)
- c.
$$\frac{\Delta \text{ Shaft Angle}}{\Delta \text{ Time}} = \text{---} \text{ deg/sec}$$

The Shaft Slew Rate shall be 0.20 ± 0.04 deg/sec.

6.2.13.23 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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6.2.14.4.10.1 The inner gimbal stabilization loop response time shall be less than 0.2 seconds.

6.2.14.4.10.2 The maximum number of overshoots on the IGA Servo Error signals shall be two.

6.2.14.5 Middle Gimbal Response Test

6.2.14.5.1 Enter code 2028000000 into C-START MODULE 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2147 MGA SERVO ERROR on 4A1-A3-CH1.

6.2.14.5.2 Enter VERB 41 NOUN 20 into K148. Press ENTER.

6.2.14.5.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.

6.2.14.5.4 Enter VERB 42 into K148. Press ENTER.

6.2.14.5.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.

6.2.14.5.6 Enter 0100 into 4A2-A6-R155. The top part of switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.

6.2.14.5.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the MG Stabilization Loop.

CAUTION: If the transient caused by the step input does not die within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.

6.2.14.5.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.

6.2.14.5.9 Enter 0000 into 4A2-A6-R155. The top part of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press XEQ/SEAL pushbutton to remove the step input to the MG stabilization loop.

6.2.14.5.10 After the transients have died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step (initial disturbance) and the peak of the first overshoot. In addition, record the total number of overshoots.

6.2.14.5.10.1 The middle gimbal stabilization loop response time shall be less than 0.2 seconds.

6.2.14.5.10.2 The maximum number of overshoots on the MGA Servo Error signals shall be two.

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6.2.14.6 Outer Gimbal Response Test

6.2.14.6.1 Enter code 2026000000 in C-START Module 4A1-A5-C156. Press XEQ/SEAL Pushbutton to call up CG 2177 OGA SERVO ERROR on 4A1-A3-CH1.

6.2.14.6.2 Enter VERB 41 NOUN 20 into K148. Press ENTER.

6.2.14.6.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.

6.2.14.6.4 Enter VERB 42 into K148. Press ENTER pushbutton.

6.2.14.6.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.

6.2.14.6.6 Enter 0010 into 4A2-A6-R155. The top half of the switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.

6.2.14.6.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the OG Stabilization Loops.

NOTE: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.

6.2.14.6.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.

6.2.14.6.9 Enter 0000 into 4A2-A6-R155. The top half of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the OG Stabilization Loop.

6.2.14.6.10 After the transients have died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step (initial disturbance) and the peak of the first overshoot. In addition, record the total number of overshoots.

6.2.14.6.10.1 The outer gimbal stabilization loop response time shall be less than 0.2 seconds.

6.2.14.6.10.2 The maximum number of overshoots on the OGA Servo Error Signals shall be two.

6.2.14.7 Enter VERB 40 NOUN 20 into K148. Press the ENTER pushbutton.

6.2.14.7.1 Enter VERB 41 NOUN 20 into K148. Press the ENTER pushbutton.

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- 6.2.14.7.2 Enter +00000 into K148. Press the ENTER pushbutton.
- 6.2.14.7.3 Enter +00000 into K148. Press the ENTER pushbutton.
- 6.2.14.7.4 Enter +00000 into K148. Press the ENTER pushbutton.
- 6.2.15 IRIG Scale Factor Test
- 6.2.15.1 Proceed with this test if the Operate Power On Test of 6.2.3 or the Turn On Procedure of 6.2.5.2 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 before proceeding.
- 6.2.15.2 Verify that the IMU OPERATE power has been applied for a minimum of 1 hour, and that at least 1 hour has elapsed since running of the Gimbal Friction Test, 6.2.7.
- 6.2.15.3 Set up the Analog Recorders to monitor the following signals:
- a. CG 2117 IG SERVO ERROR
 - b. CG 2147 MG SERVO ERROR
 - c. CG 2177 OG SERVO ERROR
 - d. CG 2120 IG TM CURRENT
 - e. CG 2150 MG TM CURRENT
 - f. CG 2180 OG TM CURRENT
- 6.2.15.3.1 Start the analog recorder chart drive using a chart speed of 1 mm/sec. The recorder shall run for the duration of 6.2.15.
- 6.2.15.4 Enter VERB 57 into K148. Press the ENTER pushbutton.
- 6.2.15.5 Enter 00005 into K148. Press the ENTER pushbutton.
- 6.2.15.6 VERB 06 NOUN 61 shall flash on CRT and the following displayed in R1 and R2:
- R1 = +xxxxx (some Nav. Base azimuth)
- R2 = +xxxxx (some test site latitude; see Table I)

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6.2.15.7 If the values displayed in R1 and R2 are correct, proceed with test, if not perform the following sequence:

- a. To correct R1, on the K-start enter VERB 21, press ENTER pushbutton, ~~xxxx.xx~~, press ENTER (~~xxxx.xx~~ is correct nav. base azimuth).
- b. To correct R2, on the K-start enter VERB 22, press ENTER pushbutton, ~~xx.xxx~~, press ENTER (obtain correct site latitude from Table I).

Table I

Site	Latitude
NAA	+33.921
MSC	+29.556
MILA	+28.516

6.2.15.8 Verify the correct displays on CRT R1 and R2, then on the K-start enter VERB 33 and press ENTER pushbutton.

6.2.15.9 VERB 21 NOUN 30 shall flash on the CRT, requesting a load of the test number.

Enter the desired test number from Table I and press the ENTER pushbutton.

Table I. Test Numbers and Positions for IRIG Tests

Test Number	Gyro Being Tested and Direction of Torque
+00001	+X
+00002	+Y
+00003	+Z
-00001	-X
-00002	-Y
-00003	-Z

NOTE: If all gyros are being tested, the test must be repeated once for each Test Number in Table I in the sequence listed. If only one gyro is being tested, the test need only be repeated for the two applicable Test Numbers.

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6.2.15.10 After 160 seconds VERB 06 NOUN 66 shall flash on the CRT. Record the value displayed in register R1 for the appropriate Test Number in Table 2. The data displayed in the Scale Factor error in parts per million. The recorded Scale Factor error shall not exceed ± 1750 ppm.

Table 2. Display of Test Parameters

Test Number	Symbol	Display in R1
-00001	E+A	±xxxxx
+00001	E-X	±xxxxx
-00002	E-Y	±xxxxx
+00002	E-Y	±xxxxx
-00003	E-Z	±xxxxx
+00003	E-Z	±xxxxx

- 6.2.15.11 Enter VERB 33 into K148. Press the ENTER pushbutton.
- 6.2.15.12 Repeat 6.2.15.8 through 6.2.15.10 until all Test Numbers in Table I have been utilized.
- 6.2.15.13 Enter VERB 34 into K148. Press the ENTER pushbutton.
- 6.2.15.13.1 After completion of all test numbers, stop the analog recorders.
- 6.2.15.14 Enter VERB 40 NOUN 20 in K143. Press the ENTER pushbutton.
- 6.2.15.14.1 Enter VERB 41 NOUN 20 into K146. Press the ENTER pushbutton.
- 6.2.15.14.2 Enter +00000 into K148 three times, pressing the ENTER pushbutton after each entry.
- 6.2.16 IMU Performance Test
- 6.2.16.1 Proceed with this test if the Operate Power On Test or 6.2.3 or the Turn On Procedure of 6.2.5.2 has been completed and system operation has not been interrupted. If the system operation has been interrupted, perform Turn On Procedure of 6.2.5.2 before proceeding with this test.
- 6.2.16.2 Enter VERB 01 NOUN 10 into K148. Press the ENTER pushbutton. Record R1 = AAAAA and the time of day.
- 6.2.16.3 Enter VERB 21 NOUN 02 into K148. Press the ENTER pushbutton. Enter 01300 into K148. Press ENTER. Enter AAAAA into K146. Press ENTER.
- 6.2.16.4 Enter VERB 06 NOUN 02 into K148. Press ENTER. Enter 01300 into K143. Press ENTER. Record R1 = BBBB.

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6.2.16.5 Perform the following calculations:

- a. $\frac{R1 (BBBBB) \times 5.12}{3600} = CCCC.C$ (hrs. in high order scaler channel 3).
- b. $23.3 - CCC.C = DDDDD$ Hrs.
- c. Add DDDDD to time of day recorded in step 1.

Do Not enter any of the PIPA scale factor tests within -0.2 hours of the time of day calculated in step 6.2.16.5c. This is the time at which the high order scaler, channel 3, will overflow. If a PIPA scale factor test is being performed at this time, unacceptable test results will occur.

6.2.16.6 Verify that the IMU Operate Power has been applied for at least one hour

6.2.16.7 Test Initiation.

6.2.16.7.1 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.16.7.2 Enter 00001 into K148. Press the ENTER pushbutton.

6.2.16.7.3 VERB 06 NOUN 61 shall appear flashing on CRT and will contain the following information:

R1 = xxx.xx (Some NB Azimuth)
R2 = xx.xxx (Some Test Site Latitude)

Insure that R1 = Correct NB Azimuth and R2 = Present Test Site Latitude from Table XX.

6.2.16.7.4 If R1 does not contain the correct NB Azimuth, enter the following sequence into K148.

- a. VERB 21, ENTER
- b. +xxx.xx, ENTER (where +xxxxx is the NB Azimuth)

6.2.16.7.5 If R2 does not contain present Test Site Latitude enter the following sequence into K148:

- a. VERB 22, ENTER
- b. Proper Data from Table XX, ENTER

Table XX

Location	Latitude
NAA	+33.921
MSC	+29.556
MILA	+28.516

6.2.16.7.6 Enter VERB 33 into K148. Press ENTER pushbutton.

6.2.16.7.7 VERB 06 NOUN 66 shall appear flashing on CRT. Verify that the following values appear on CRT.

R1 = +00900 R3 = +00001
R 2 = +00000

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- 6.2.16.7.8 If the contents of R1 on the CRT are not +00900, enter the following sequence into K148.
- a. VERB 21, ENTER
 - b. +00900, ENTER
- 6.2.16.7.9 If the contents of R3 on the CRT are not +00000, enter the following sequence into K148:
- a. VERB 22, ENTER
 - b. +00000, ENTER
- 6.2.16.7.10 If the contents of R3 on the CRT are not +00001, enter the following sequence into K148:
- a. VERB 23, ENTER
 - b. +00001, ENTER
- 6.2.16.7.11 Verify correct display in R1, R2, and R5. Enter VERB 33 into K148. Press the ENTER pushbutton.
- 6.2.16.7.12 After approximately 17 minutes, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the value on CRT for R2 on the calculation sheet.
- 6.2.16.7.13 Enter VERB 33 into K148. Press the ENTER pushbutton.
- 6.2.16.7.14 After approximately 90 sec, VERB 06, NOUN 66 shall appear flashing on the CRT. Record the value on CRT for R1 and R2 on the calculation sheet.
- 6.2.16.7.15 Enter VERB 34 into K148. Press the ENTER pushbutton.
- 6.2.16.7.16 Repeat steps 6.2.16.3.7 through 6.2.16.3.14, substituting position number +00002 in R3.
- 6.2.16.7.17 Enter VERB 33 into K148. Press ENTER pushbutton.
- 6.2.16.7.18 After approximately 67 minutes, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the value on CRT for R2 on the calculation sheet.
- 6.2.16.7.19 Repeat steps 6.2.16.3.6 through 6.2.16.3.14, substituting position number +00003 in R3.
- 6.2.16.7.20 Repeat steps 6.2.16.3.15 through 6.2.16.3.18, substituting position number +00004 in R3.
- 6.2.16.7.21 Enter VERB 33 into K148. Press ENTER pushbutton.

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6.2.16.7.22 VERB 06 NOUN 66 shall flash on the CRT. Verify the following data is also displayed on the CRT.

- a. R1 = +00900
- b. R2 = +00000
- c. R3 = +00005

If data is incorrect perform steps 6.2.16.3.8 thru 6.2.16.3.10 entering the correct data. Enter VERB 33 into K148. Press ENTER pushbutton.

The PROGRAM ALARM and GIMBAL LOCK status lights shall be illuminated on the DUKY.

6.2.16.7.23 Press the RESET pushbutton. The Program Alarm lamp shall extinguish. In approximately 90 sec, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the data displayed in R1 and R2 on the CRT.

6.2.16.7.24 Enter VERB 34 into K148. Press ENTER pushbutton. Repeat steps 6.2.16.3.22 thru 6.2.16.3.23 substituting position no. +00006.

6.2.16.7.25 Enter VERB 34 into K148. Press the ENTER pushbutton. VERB 06 NOUN 66 shall flash on the CRT. Verify the following data is also displayed on the CRT.

- a. R1 = +00900
- b. R2 = +00000
- c. R3 = +00007

If the data is incorrect perform steps 6.2.16.3.8 thru 6.2.16.3.10 entering the correct data.

6.2.16.7.26 Enter VERB 33 into K148. Press ENTER pushbutton. The GIMBAL LOCK status lamp shall extinguish. In approximately 17 minutes VERB 06 NOUN 66 shall flash on the CRT. Record the data displayed in R2 of the CRT.

6.2.16.7.27 Repeat steps 6.2.16.3.25 and 6.2.16.3.26 substituting position no. +00008 in R3.

6.2.16.7.28 Repeat steps 6.2.16.3.25 and 6.2.16.3.26 substituting position no. +00009 in R3.

6.2.16.7.29 Repeat steps 6.2.16.3.25 and 6.2.16.3.26 substituting position no. +00010 in R3.

6.2.16.8 To terminate the IMU Performance Test, enter VERB 36 into K148. Press ENTER pushbutton.

6.2.16.9 Enter the following sequence in K148.

- a. VERB 40 NOUN 20, ENTER
- b. VERB 41 NOUN 20, ENTER
- c. +00000, ENTER
- d. +00000, ENTER
- e. +00000, ENTER

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6.2.16.10 Calculations

Table XXI

Position No. As Displayed in R3	Quantity Being Measured
+00001	+NEDY +X PIPA G
+00002	+NBDZ -X PIPA G -NBDX + ADIAX
+00003	-NEDX +Z PIPA G
+00004	+NBDY + ADSRAY -Z PIPA G +NBDZ + ADIAZ
+00005	+ Y PIPA G
+00006	- Y PIPA G
+00007	-NBDX + .707 ADSRAX
+00008	.707 (-NBDZ - NEDY) + .5 (ADIAZ - ADIAY) +.5 (ADSRAY + ADSRAZ)
+00009	-NBDZ + .707 ADSRAZ
+00010	.707 (NBDY - NBDX) + .5 (ADIAY - ADIAX) +.5 (ADSRAX)

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6.2.16.10.1 Measured Values

	Line	Position No.	Step No.	Parameter	Recorded Value
6.2.16.10.1.1	1	+00001	6.2.16.7.12	+NBDY	R2
6.2.16.10.1.2	2	+00001	6.2.16.7.14	+YPIPAG	R1 . R2
6.2.16.10.1.3	3	+00002	6.2.16.7.12	+NBDZ	R2
6.2.16.10.1.4	4	+00002	6.2.16.7.14	-XPIPAG	R1 . R2
6.2.16.10.1.5	5	+00002	6.2.16.7.18	-NGDX + ADIAK	R2
6.2.16.10.1.6	6	+00003	6.2.16.7.12	-NBDX	R2
6.2.16.10.1.7	7	+00003	6.2.16.7.14	+ZPIPAG	R1 . R2
6.2.16.10.1.8	8	+00004	6.2.16.7.12	+NBDY + ADSRAY	R2
6.2.16.10.1.9	9	+00004	6.2.16.7.14	-ZPIPAG	R1 . R2
6.2.16.10.1.10	10	+00004	6.2.16.7.18	+NBDZ + ADIAZ	R2
6.2.16.10.1.11	11	+00005	6.2.16.7.23	+YPIPAG	R1 . R2
6.2.16.10.1.12	12	+00006	6.2.16.7.23	-YPIPAG	R1 . R2
6.2.16.10.1.13	13	+00007	6.2.16.7.26	-NBDX + .707ADSRAX	R2
6.2.16.10.1.14	14	+00008	6.2.16.7.26	.707 (-NBDZ- NBDY) + .5 (ADIAZ-ADIAK) +.5 (ADSRAY + ADSRAZ)	R2
6.2.16.10.1.15	15	+00009	6.2.16.7.26	-NBDZ + .707ADSRAX	R2
6.2.16.10.1.16	16	+00010	6.2.16.7.26	.707(NBDY - NBDX) + .5 (ADIAZ - ADIAK) + .5 ADSRAX	R2

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6.2.16.10.2 Compute the average G for each PIPA using the recorded values in 6.2.16.6.1

a. For XPIPA, $G_x = \frac{\text{line 2} - \text{line 4}}{2} =$

b. For YPIPA, $G_y = \frac{\text{line 11} - \text{line 12}}{2} =$

c. For ZPIPA, $G_z = \frac{\text{line 7} - \text{line 9}}{2} =$

6.2.16.10.3 Compute the PIPA scale factor from the values obtained in 6.2.16.6.2 and the value of local gravity obtained from Table XXII as follows:

a. $h_x = \frac{5.85(\text{local } g)}{G_x} =$

b. $h_y = \frac{5.85(\text{local } g)}{G_y} =$

c. $h_z = \frac{5.35(\text{local } g)}{G_z} =$

6.2.16.10.3.1 The PIPA scale factor shall be 5.85000 ± 0.00234 cm/sec/pulse.

Table XXII. Local Gravity Requirements

Location	Local Gravity (cm/sec ²)
NAA	979.56
MSC	979.29
MILA	979.24

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6.2.16.10.4 Compute the PIPA bias values using the values obtained in 6.2.16.6.2 as follows:

a. $b_x = \frac{\text{line 2} + \text{line 4}}{2} =$

b. $b_y = \frac{\text{line 11} + \text{line 12}}{2} =$

c. $b_z = \frac{\text{line 7} + \text{line 9}}{2} =$

6.2.16.10.4.1 The PIPA bias values shall not exceed 0.50 cm/sec^2 .

6.2.16.10.5 Calculate NBD, ADSRA. ADIA using the values obtained in 6.2.16.6.2.

a. $\text{NBDX} = -(\text{line 6}) =$

$\text{NBDY} = \text{line 1} =$

$\text{NBDZ} = +(\text{line 3}) =$

b. $\text{ADSRAX} = \frac{(\text{line 13} - \text{line 6})}{.707}$

$\text{ADSRAY} = \text{line 8} - \text{line 1}$

$\text{ADSRAZ} = \frac{+\text{line 15} + \text{line 3}}{.707}$

c. $\text{ADIAX} = \text{line 5} - \text{line 6}$

$\text{ADIAZ} = \frac{\text{line 16} - .707(\text{NBDY} - \text{NBDX}) - .5(\text{ADSRAX} - \text{ADIAZ})}{.5}$

$\text{ADIAZ} = \text{line 10} - \text{line 3}$

6.2.16.10.5.1 Obtain the following values from the latest performance of JDC 12217 at AC Electronics.

a. $\text{NBDX} = \underline{\hspace{2cm}} \text{ meru}$
 $\text{NBDY} = \underline{\hspace{2cm}} \text{ meru}$
 $\text{NBDZ} = \underline{\hspace{2cm}} \text{ meru}$

b. $\text{ADSRAX} = \underline{\hspace{2cm}} \text{ meru}$
 $\text{ADSRAY} = \underline{\hspace{2cm}} \text{ meru}$
 $\text{ADSRAZ} = \underline{\hspace{2cm}} \text{ meru}$

c. $\text{ADIAX} = \underline{\hspace{2cm}} \text{ meru}$
 $\text{ADIAZ} = \underline{\hspace{2cm}} \text{ meru}$
 $\text{ADIAZ} = \underline{\hspace{2cm}} \text{ meru}$

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6.2.16.7.6

Calculate Δ NBD, Δ ADSRA, and Δ ADIA by taking the differences between the respective NBD, ADSRA, and ADIA terms in 6.2.16.5 and 6.2.16.5.1.

- a. Δ NBDX = _____ meru
 Δ NBDY = _____ meru
 Δ NBDZ = _____ meru
- b. Δ ADSRAX = _____ meru
 Δ ADSRAY = _____ meru
 Δ ADSRAZ = _____ meru
- c. Δ ADIAX = _____ meru
 Δ ADIAY = _____ meru
 Δ ADIAZ = _____ meru

Δ NBD shall not exceed ± 5 meru.

Δ ADSRA shall not exceed ± 10 meru.

Δ ADIA shall not exceed ± 15 meru.

6.2.16.7.6.1

Evaluate results to determine IMU Performance Test passed or failed.

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- 6.2.17 SXT-NB-IMU Fine Alignment Test
- 6.2.17.1 Proceed with this test if the Operate Power On Test 6.2.3 has been completed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2.
- 6.2.17.2 Prior to performing this test, the G&N Installation Qualification fixture shall be installed on the supporting fixture and adjusted to permit proper operation of the G&N optics. The azimuth supplied by the azimuth autotest (Optical Reference No. 1) shall be known to ± 30 minutes of arc.
- NOTE: The G&N shall have had OPERATE power applied for a minimum of 1 hour. Set the G/N POWER-OPTICS switch to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0 \pm 3.0 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTIX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.
- 6.2.17.3 Enter VERB 01 NOUN 10 into K148 Press the ENTER pushbutton. Record R1 = AAAAA and the time of day.
- 6.2.17.4 Enter VERB 21 NOUN 02 into K148 press the ENTER pushbutton. Enter AAAAA into K148. Press ENTER.
- 6.2.17.5 Enter VERB 06, NOUN 02 into K148. Press ENTER. Enter 01300 into K148. Press ENTER. Record R1 = BBBBB.
- 6.2.17.6 Perform the following calculations:
- $\frac{R1 (BBBBB) \times 5.12}{3600} = CCCC.C$ (Hrs. in high order scaler channel 3)
 - 23.3 - CCCC.C = DDDDD Hrs.
 - Add DDDDD to time of day recorded in step 1.
- DO NOT enter any of the PIPA misalignment tests within -0.2 hours of the time of day calculated in step 6.2.17.6c. This is the time at which the high order scaler, channel 3, will overflow. If a PIPA misalignment test is being performed at this time, unacceptable test results will occur.
- 6.2.17.7 Enter the following sequence into the Lower Equipment Bay (LEB) DSKY.
- VERB 41 NOUN 20 ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER
- 6.2.17.8 On the G&N Indicator Control Panel set the following switches to the position indicated.
- TELESCOPE TRUNNION to SLAVE to SXT
 - CONTROLLER COUPLING to DIRECT
 - CONTROLLER SPEED to LO
 - OPTICS MODE TO ZERO

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6.2.17.9 Initiate the test by entering the following sequence into the LEB DSKY.

- a. VERB 57, ENTER
- b. 00003, ENTER

6.2.17.10 Observe VERB 06 NCUN 66 flashing on the DSKY. The following data is displayed in R1 and R2 on the DSKY.

- a. R1 = +13500
- b. R2 = +xx.xxx (Site Latitude from Table I)

Table 1

Test Site	Latitude
NAA	+33.922
MILA	+28.516
MSC	+29.556

6.2.17.11 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If the value displayed is other than +13500 in R1 and the correct Site Latitude in R2, correct the data by entering the following sequence into the DSKY.

- a. VERB 21, ENTER
- b. +13500, ENTER
- c. VERB 22, ENTER
- d. +xx.xxx, ENTER (+xx.xxx = Site Latitude from Table I)
- e. VERB 33, ENTER

6.2.17.12 Observe VERB 21 NCUN 30 flashing on the DSKY. Enter the following sequence into the DSKY.

- a. +00001, ENTER (Position Number)
- b. +00000, ENTER
- c. +00001, ENTER

6.2.17.13 Observe VERB 06 NCUN 66 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.

- a. R1 = +xxx.xx (γ_{NB} Azimuth)
- b. R2 = +xx.xxx (γ_{NB} Elevation)
- c. R3 = 00001

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6.2.17.14 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct Y_{NB} azimuth and elevation, correct the data by entering the following sequence into the DSKY.

- VERB 24, ENTER
- +xxx.xx \pm 002.00 degrees, ENTER (Y_{NB} azimuth)
- +xx.xxx \pm 02.000 degrees, ENTER (Y_{NB} elevation)
- VERB 33, ENTER

6.2.17.15 Observe VERB 06 NOUN 66 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.

- R1 = +xxx.xx (Z_{NB} Azimuth)
- R2 = +xx.xxx (Z_{NB} Elevation)
- R3 = 00002

6.2.17.16 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct Z_{NB} azimuth and elevation, correct the data by entering the following sequence into the DSKY.

- VERB 24, ENTER
- +xxx.xx \pm 002.00 degrees, ENTER (Z_{NB} Azimuth)
- +xx.xxx \pm 02.000 degrees, ENTER (Z_{NB} elevation)
- VERB 33, ENTER

6.2.17.17 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.

- R1 = +xxx.xx (Target 1 Azimuth)
- R2 = +xx.xxx (Target 1 Elevation)
- R3 = 00001

6.2.17.18 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct azimuth and elevation for Target 1, correct the data by entering the following sequence into the DSKY.

- VERB 24, ENTER
- +xxx.xx \pm 000.10 degrees, ENTER (Target 1 Azimuth)
- +xx.xxx \pm 00.010 degrees, ENTER (Target 1 Elevation)
- VERB 33, ENTER

6.2.17.19 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.

- R1 = +xxx.xx (Target 2 Azimuth)
- R2 = +xx.xxx (Target 2 Elevation)
- R3 = 00002

6.2.17.20 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct azimuth and elevation for Target 2, correct the data by entering the following sequence into the DSKY.

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- a. VERB 24, ENTER
- b. +xxx.xx + 000.10 degrees, ENTER (Target 2 Azimuth)
- c. +xx.xxx + 00.010 degrees, ENTER (Target 2 Elevation)
- d. VERB 33, ENTER

- 6.2.17.21 When VERB 51 NOUN 30 flashes on the DSKY set the OPTICS MODE switch on the G&N Indicator Control Panel to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.
- 6.2.17.22 Using the Optics Hand Controller, align the SXT StLOS with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.23 When VERB 51 NOUN 30 flashes on the DSKY set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.
- 6.2.17.24 Using the Optics Hand Controller, align the SXT StLOS with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.25 Repeat steps 6.2.17.17 through 6.2.17.20.
- 6.2.17.26 In approximately 7 minutes VERB 06 NOUN 66 shall flash on the DSKY and the test results shall be displayed. R1 and R2 on the DSKY shall display the misalignment of one of the horizontal PIPA's in arc seconds (R1 = whole, R2 = fractional). Record R1 and R2. (See Table II for PIPA displayed).
- 6.2.17.27 Enter VERB 33 ENTER into the DSKY. When VERB 06 NOUN 66 flashes R1 and R2 on the DSKY shall display the misalignment of the second horizontal PIPA in arc seconds (R1 whole, R2 fractional). (See Table II for PIPA displayed.) Record R1 and R2.

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- 6.2.17.28 Enter VERB 34 ENTER into the DSKY to terminate the test.
- 6.2.17.29 Repeat steps 6.2.17.4 through 6.2.17.24 substituting position No. 00002 in 6.2.17.8a.
- 6.2.17.30 Enter the following sequence into the DSKY:
- a. VERB 41 NOUN 20, ENTER
 - b. +00000, ENTER
 - c. +00000, ENTER
 - d. +00000, ENTER

Table II. Display Conditions at Test Completion

Position	SM Orientation			6.2.17.22	6.2.17.23
	X _{SM}	Y _{SM}	Z _{SM}		
1	UP	SW	SE	Y PIPA about Z PIPA	Z PIPA about Y PIPA
2	SE	SW	DN	X PIPA about Y PIPA	Y PIPA about X PIPA
3 *	SE	UP	SW	X PIPA about Z PIPA	Z PIPA about X PIPA

* Position 3 is not run in the Spacecraft because of GIMBAL LOCK considerations.

- 6.2.17.31 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.
- 6.2.17.32 Calculations

- 6.2.17.32.1
- a. Y PIPA about Z misalignment = $\left\{ \begin{matrix} R1 \\ R2 \end{matrix} \right\}$
 - b. Z PIPA about Y misalignment = $\left\{ \begin{matrix} R1 \\ R2 \end{matrix} \right\}$
 - c. X PIPA about Y misalignment = $\left\{ \begin{matrix} R1 \\ R2 \end{matrix} \right\}$
 - d. Y PIPA about X misalignment = $\left\{ \begin{matrix} R1 \\ R2 \end{matrix} \right\}$

- 6.2.17.32.2 Enter the latest values from 6.2.16 IMU Performance Test.

- a. X PIPA bias = _____ cm/sec²
- b. Y PIPA bias = _____ cm/sec²
- c. Z PIPA bias = _____ cm/sec²
- d. $\theta_x = 210$ (X PIPA bias) = _____ arc sec.
- e. $\theta_y = 210$ (Y PIPA bias) = _____ arc sec.
- f. $\theta_z = 210$ (Z PIPA bias) = _____ arc sec.

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6.2.17.32.3

- a. Y PIPA about Z misalignment (Bias corrected) =
6.2.17.27.1a - θ_y = _____ arc sec.
- b. Z PIPA about Y misalignment (Bias corrected) =
6.2.17.27.1b - θ_z = _____ arc sec.
- c. X PIPA about Y misalignment (Bias corrected) =
6.2.17.27.1c - θ_x = _____ arc sec.
- d. Y PIPA about X misalignment (Bias corrected) =
6.2.17.27.1d - θ_y = _____ arc sec.

The PIPA misalignments, excluding PIPA bias, shall not exceed ± 150 arc seconds.

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- 6.2.18 Gyrocompassing Test
- NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure.
- 6.2.18.1 Set the G/N POWER-OPTICS Switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0 \pm 3.0 VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90° h (CG1212) are not flashing on the CRT.
- 6.2.18.2 Enter the following sequence into the K-Start, pressing ENTER pushbutton after each entry.
- VERB 57, ENTER
 - 00006, ENTER
- 6.2.18.3 System shall advance to Gyrocompass System Test and display 01 on the CRT program display.
- 6.2.18.4 On the CRT observe VERB 06, NOUN 61 flashing with some launch azimuth displayed in R1 = +xxx.xx.
- 6.2.18.4.1 If the azimuth displayed is correct proceed to 6.2.18.5; if not, perform the following sequence:
- VERB 21, Press ENTER pushbutton
 - +xxx.xx, press ENTER pushbutton (Correct Launch Azimuth)
- 6.2.18.5 After verifying that the correct launch azimuth is displayed in R1 on the CRT, Enter VERB 33 on the K-START and push the ENTER pushbutton.
- 6.2.18.6 Observe VERB 06 NOUN 61 flashing on the CRT with the following displayed in R1 and R2.
- R1 = ±xxx.xx, Nav. Base Azimuth (Z_{NB})
 - R2 = ±xx.xxx, Site Latitude
- 6.2.18.6.1 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence:
- To correct R1:
- VERB 21, ENTER
 - +xxx.xx \pm 000.50 degrees, ENTER (Z_{NB} Azimuth)
- To correct R2:
- Verb 22, ENTER
 - +xx.xxx, ENTER (Correct Site Latitude from Table D)

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- 6.2.18.7 After the correct data for R1 and R2 are verified enter VERB 33 into the K-Start. Press the ENTER pushbutton. On the CRT observe the PROGRAM display change to 05 after approximately 90 seconds. After approximately 15 minutes, observe the PROGRAM display change to 02.
- 6.2.18.8 After 120 minutes set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.9 Enter VERB 52 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT change to 03.
- 6.2.18.10 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 1 azimuth and elevation.
- R1 = +xxx.xx (Target 1 azimuth)
 - R2 = +00.000 (Target 1 elevation)
- 6.2.18.11 Verify the data appearing in R1 and R2 and if correct, proceed. If not correct, perform the following sequence.
- VERB 24, ENTER
 - +xxx.xx + 000.01, ENTER (Target 1 azimuth)
 - +00.000, ENTER (Target 1 elevation)
- 6.2.18.12 After the correct readings for R1 and R2 are verified, enter VERB 33 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.13 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 2 azimuth and elevation.
- R1 = +xxx.xx (Target 2 azimuth)
 - R2 = +00.000 (Target 2 elevation)
- 6.2.18.14 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence.
- VERB 24, ENTER
 - +xxx.xx + 000.01, ENTER (Target 2 azimuth)
 - +00.000, ENTER (Target 2 elevation)
- 6.2.18.15 After the correct readings for R1 and R2 are verified enter VERB 33 into the K-Start. Press the ENTER pushbutton.

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- 6.2.18.16 On the G&N Indicator Control Panel set the OPTICS MODE switch to MAN and the CONTROLLER SPEED to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target 1.
- 6.2.18.17 Set the CONTROLLER SPEED switch on the G&N Indicator Control Panel to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 1 and press the MARK pushbutton. If satisfied that the MARK was good, proceed. If not satisfied with MARK, press the MARK REJECT pushbutton and repeat the step.
- 6.2.18.18 Set the CONTROLLER SPEED switch to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target 2.
- 6.2.18.19 Set the CONTROLLER SPEED switch to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 2 and press the MARK pushbutton. If satisfied that the MARK was good, press the ENTER pushbutton. If not satisfied, press the MARK REJECT pushbutton and repeat this step.
- 6.2.18.20 On the CRT observe the following data displayed:
- VERB 06 NOUN 60
 - R1 = +xx.xxx (X gyre elevation error, degrees)
 - R2 = +xx.xxx (Y gyre elevation error, degrees)
 - R3 = +xx.xxx (Z gyre azimuth error, degrees)
- Record R1, R2 and R3.
- 6.2.18.21 Enter VERB 34 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT and DSKY's indicates 02. Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.22 Repeat steps 6.2.18.9 through 6.2.18.21 for the next hour at the following intervals.
- 15 minutes
 - 30 minutes
 - 45 minutes
 - 60 minutes

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6.2.18.23 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

6.2.18.24 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start three times. Press the ENTER pushbutton after each entry. Set the G/N POWER-OPTICS Switch on the LEB Lighting Control Panel to OFF.

6.2.18.25 Data Sheet

Line	Step No.	Parameter	Recorded Value
	6.2.18.20		
1		X Gyro Elevation Error	+ <u>R1</u> degrees
2		Y Gyro Elevation Error	+ <u>R.2</u> degrees
3		Z Gyro Azimuth Error	+ <u>R.3</u> degrees
	6.2.18.22.a		
4		X Gyro Elevation Error	+ <u>R.1</u> degrees
5		Y Gyro Elevation Error	+ <u>R.2</u> degrees
6		Z Gyro Azimuth Error	+ <u>R.3</u> degrees
	6.2.18.22b		
7		X Gyro Elevation Error	+ <u>R.1</u> degrees
8		Y Gyro Elevation Error	+ <u>R.2</u> degrees
9		Z Gyro Azimuth Error	+ <u>R.3</u> degrees
	6.2.18.22c		
10		X Gyro Elevation Error	+ <u>R.1</u> degrees
11		Y Gyro Elevation Error	+ <u>R.2</u> degrees
12		Z Gyro Azimuth Error	+ <u>R.3</u> degrees
	6.2.18.22d		
13		X Gyro Elevation Error	+ <u>R.1</u> degrees
14		Y Gyro Elevation Error	+ <u>R.2</u> degrees
15		Z Gyro Azimuth Error	+ <u>R.3</u> degrees

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6.2.18.26 Calculations Sheet

6.2.18.26.1 Record the most recent values of the following coefficients from 6.2.16, IMU Performance Test.

- a. NBDX = () _____
- b. NBDY = () _____
- c. NBDZ = () _____
- d. ADIAZ = () _____
- e. ADSRAY = () _____

6.2.18.26.2 Perform the following calculations. (Cos λ functions are provided in Table I.)

- a. $D(\text{vert}) = \text{NBDZ} - \text{ADIAZ}$
 $D(\text{vert}) = () \text{ } ______ \text{ } \text{meru}$
- b. $D(\text{east}) = \begin{matrix} \text{Sin (Launch Azimuth)} & \text{NBDX} + \\ \text{Cos (Launch Azimuth)} & \text{NBDY} + \text{ADSRAY} \end{matrix}$
- c. $\phi(\text{vert}) = \frac{D(\text{vert}) \times 24.2 + D(\text{east}) \times 206.26981}{3600 (\text{Cos } \lambda)}$
 $\phi(\text{vert}) = () \text{ } ______ \text{ } \text{degrees}$

Table I

Location	Latitude λ	Cos λ
NAA	33.917	0.82985
MILA	28.516	0.87868
MSC	29.556	0.86993

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6.2.18.26.3

Perform the following calculations using the recorded data from 6.2.18.25 and 6.2.18.26.2.

- a. Z Gyro azimuth error 2 hrs (corrected) = line 3 - ϕ (vert)
 . Z Gyro azimuth error 2 hrs (corrected) = _____
 Corrected Z Gyro azimuth error (corrected) shall be 0.00
 \pm 0.57 degrees
- b. X Gyro elevation error (2 hr) = line 1
 X Gyro elevation error (2 hr) = _____ degrees
- c. Y Gyro elevation error (2 hr) = line 2
 Y Gyro elevation error (2 hr) = _____ degrees
 The X and Y Gyro elevation errors shall be
 0.00 \pm 0.06 degrees.
- d. Δ Z Gyro azimuth error (3 hr) = line 3 - line 15
 Δ Z Gyro azimuth error (3 hr) = _____ degrees
 Δ Z Gyro azimuth error shall be 0.00 \pm 0.06 degrees.
- e. Δ X Gyro elevation error (3 hr) = line 1 - line 13
 Δ X Gyro elevation error (3 hr) = _____ degrees
- f. Δ Y Gyro elevation error (3 hr) = line 2 - line 14
 Δ Y Gyro elevation error (3 hr) = _____ degrees
 Δ X and Δ Y Gyro elevation error shall be 0.00 \pm 0.03 degrees.

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6.2.19 CMC Voltage Margin Test

6.2.19.1 Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 Turn On Procedure.

6.2.19.2 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to ON.

Caution: During the performance of this test the +4 VDC CMC Power Supply shall not be operated at less than +2.5 VDC or greater than 5.2 VDC (CG 1030). The +14 VDC CMC Power Supply shall not be operated at less than +8.5 VDC or greater than +17.0 VDC (CG 1020).

Note: The flashing indication of the CMC Power Supplies on CRT may be disregarded for this test. The charts in Table I may be used to determine approximate values for the "XX.X" values of C-156 voltage dial settings corresponding to various power supply voltages.

6.2.19.3 Units R-154 insert 0111. Verify and execute.

6.2.19.4 Insert in C-156 + XX.X001244 (Enter a value for XX.X which will adjust the +14 VDC Power Supply (CG1020) to 12.2 (+0.3, -0.0) VDC). Execute. Verify CG1020 on the CRT.

6.2.19.5 Insert in C-156 + XX.X001234 (Enter a value for XX.X which will adjust the +4 VDC Power Supply (CG1030) to 3.5 (+0.15, -0.0) VDC). Execute. Verify CG1030 on the CRT.

6.2.19.6 On K-148 press ERROR RESET

6.2.19.7 Initiate CMC Self-Check by inserting the following into K-148.

- a. VERB 21 NOUN 27, ENTER
- b. 77777, ENTER

Wait 200 seconds. Verify RESTART lamp on DSKY is not lighted.

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- 6.2.19.8 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on DSKY is lighted.
- 6.2.19.9 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to ON. Press ERROR RESET. Insert 11 to K-148:
- a. VERB 21, NOUN 27, ENTER
b. 77777, ENTER
- 6.2.19.10 Insert into C-156 + XX.X001244 (Enter a value for XX.X which will adjust the +14 VDC CMC. Power Supply (CG1020) to +16.4 (0.0, -0.4) VDC). Execute. Verify CG1020 on the CRT.
- 6.2.19.11 Press ERROR RESET on K-148. Wait 200 seconds. Verify RESTART lamp on DSKY is not lighted.
- 6.2.19.12 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to off. Verify RESTART lamp on the DSKY is lighted. Set the INHIBIT VOLTAGE FAIL switch to ON. Press ERROR RESET. Insert into K-148.
- a. VERB 21 NOUN 27, ENTER
b. 77777, ENTER
- 6.2.19.13 Insert into C-156 + XX.X001234 (Enter a value for XX.X which will adjust the +4 VDC CMC Power Supply (CG1030) to 4.6 (+0.0, -0.2) VDC). Execute. Verify CG1030 on the CRT.
- 6.2.19.14 Press ERROR RESET on K-148. Wait 200 seconds. Verify RESTART lamp on DSKY is not lighted
- 6.2.19.15 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on the DSKY is lighted. Set the INHIBIT VOLTAGE FAIL switch to on. Press ERROR RESET. Insert into K-148.
- a. VERB 21 NOUN 27, ENTER
b. 77777, ENTER
- 6.2.19.16 Insert into C-156 + XX.X001244 (Enter a value for XX.X which will adjust the +14 VDC CMC Power Supply (CG1020) to 12.2 (+0.3, -0.0) VDC). Execute. Verify CG1020 on the CRT.

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6.2.19.17 Press ERROR RESET on K-148. Wait 200 seconds. Verify RESTART lamp on the DSKY is not lighted.

6.2.19.18 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on the DSKY is lighted.

6.2.19.19 Into R-154 insert 0000. Verify and execute.

6.2.19.20 Terminate the CMC Self-Check by inserting into K-148:

- a. VERB 21 NOUN 27, ENTER
- b. 00000, ENTER

Press ERROR RESET on K-148.

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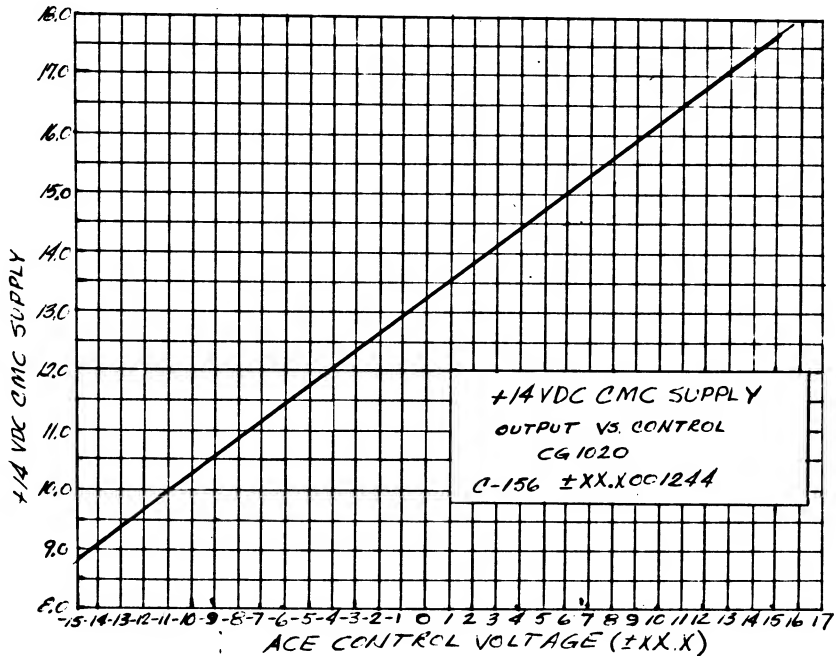
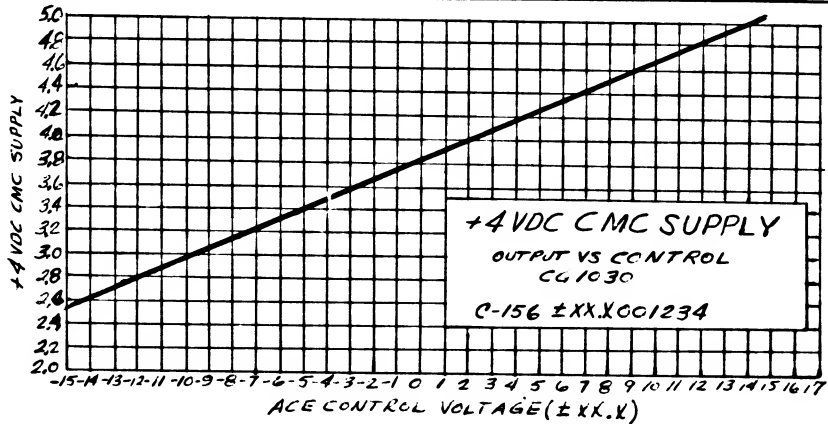


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6.2.21 Spacecraft Control and Displays Test

6.2.21.1 Proceed with this test if the Operate Power On Test of 6.2.3 and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 before proceeding.

6.2.21.2 FDAI Attitude Error

6.2.21.2.1 Insert in K148

- a. V 57 ENTER
- b. 00013 ENTER

6.2.21.2.2 Observe on CRT

- a. V 33 NO1 Flashing
- b. PROG 07
- c. NO ATT ON
- d. R1, R2, and R3 Approx. 00000

6.2.21.2.3 Insert in K148

- a. VERB 33, ENTER

6.2.21.2.4 Observe on CRT

- a. V 33 NO1 Flashing
- b. R1 +00385
- c. R2 -00385
- d. R3 +00385
- e. NO ATT OFF

6.2.21.2.5 Record CRT indications

- a. CG 2279 ROLL ATT ERROR - CDU DAC OUT +16.88 ± 1.65 degrees
- b. CG 2219 PITCH ATT ERROR - CDU DAC OUT -16.88 ± 1.65 degrees
- c. CG 2249 YAW ATT ERROR - CDU DAC OUT +16.88 ± 1.65 degrees

6.2.21.2.6 Insert in K148

- a. VERB 33, ENTER

6.2.21.2.7 Observe on CRT

- a. V 33 NO1 Flashing
- b. R1 +00384
- c. R2 -00384
- d. R3 +00384

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6.2.21.2.8 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	+16.88 ±1.65 degrees
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	+16.88 ±1.65 degrees

6.2.21.2.9 Insert in K148

a. VERB 33, ENTER

6.2.21.2.10 Observe on CRT

a.	V 33	N01	Flashing
b.	R1		+00160
c.	R2		-00160
d.	R3		+00160

6.2.21.2.11 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	+6.95 ±0.69 degrees
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	-6.95 ±0.69 degrees
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	+6.95 ±0.69 degrees

6.2.21.2.12 Insert in K148

a. VERB 33, ENTER

6.2.21.2.13 Observe on CRT

a.	V 33	N01	Flashing
b.	R1		+00135
c.	R2		-00135
d.	R3		+00135

6.2.21.2.14 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	+5.88 ±0.59 degrees
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	-5.88 ±0.59 degrees
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	+5.88 ±0.59 degrees

6.2.21.2.15 Insert in K148

a. VERB 33, ENTER

6.2.21.2.16 Observe on CRT

a.	V 33	N01	Flashing
b.	R1		+00090
c.	R2		-00090
d.	R3		+00090

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6.2.21.2.17 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	+3.93 \pm 0.39 degrees
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	-3.93 \pm 0.39 degrees
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	+3.93 \pm 0.39 degrees

6.2.21.2.18 Insert in K148

a. VERB 33, ENTER

6.2.21.2.19 Observe on CRT

a.	V 33	N01	Flashing
b.	R1		+00000
c.	R2		+00000
d.	R3		-00090

6.2.21.2.20 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	0.00 \pm 0.19 degrees
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	0.00 \pm 0.19 degrees
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	-3.93 \pm 0.39 degrees

6.2.21.2.21 Insert in K148

a. VERB 33, ENTER

6.2.21.2.22 Observe on CRT

a.	V 33	N01	Flashing
b.	R1		-00090
c.	R2		+00090
d.	R3		-00135

6.2.21.2.23 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	-3.93 \pm 0.39 degrees
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	+3.93 \pm 0.39 degrees
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	-5.88 \pm 0.59 degrees

6.2.21.2.24 Insert in K148

a. VERB 33, ENTER

6.2.21.2.25 Observe on CRT

a.	V 33	N01	Flashing
b.	R1		-00135
c.	R2		+00135
d.	R3		-00160

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6.2.21.2.26 Record CRT indications

- | | | |
|------------|-------------------------------|---------------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | -5.88 ±0.59 degrees |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +5.88 ±0.59 degrees |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | -6.95 ±0.69 degrees |

6.2.21.2.27 Insert in K148

- a. VERB 33, ENTER

6.2.21.2.28 Observe on CRT

- | | | |
|---------|-----|----------|
| a. V 33 | NO1 | Flashing |
| b. R1 | | -00160 |
| c. R2 | | +00160 |
| d. R3 | | -00384 |

6.2.21.2.29 Record CRT indications

- | | | |
|------------|-------------------------------|----------------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | -6.95 ±0.69 degrees |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +6.95 ±0.69 degrees |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | -16.88 ±1.65 degrees |

6.2.21.2.30 Insert in K148

- a. VERB 33, ENTER

6.2.21.2.31 Observe on CRT

- | | | |
|---------|-----|----------|
| a. V 33 | NO1 | Flashing |
| b. R1 | | -00384 |
| c. R2 | | +00384 |
| d. R3 | | -00385 |

6.2.21.2.32 Record CRT indications

- | | | |
|------------|-------------------------------|----------------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | -16.88 ±1.65 degrees |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +16.88 ±1.65 degrees |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | -16.88 ±1.65 degrees |

6.2.21.2.33 Insert in K148

- a. VERB 33, ENTER

6.2.21.2.34 Observe on CRT

- | | | |
|---------|-----|----------|
| a. V 33 | NO1 | Flashing |
| b. R1 | | -00385 |
| c. R2 | | +00385 |
| d. R3 | | +00000 |

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6.2.21.2.35 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+16.88 ±1.65 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	0.00 ±0.19 degrees

6.2.21.2.36 Insert in K148

a. V 21	NO1	ENTER
b. 02545		ENTER
c. 03302		ENTER
d. V 33		ENTER

6.2.21.2.37 Observe on CRT

a. V 33	NO3	Flashing
b. NO ATT		ON
c. R1		+00000 approximately
d. R2		+00000 approximately
e. R3		+00000 approximately

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6.2.21.3 TVC Test

6.2.21.3.1 The G/N Autopilot Control and SPS Ready discretes shall be applied to the G/N interface.

6.2.21.3.2 Set the OPTICS MODE selector on the Indicator Control panel to MAN.

6.2.21.3.3 Insert in K148

a. VERB 33, ENTER

6.2.21.3.4 Observe on CRT

a. V 01	N 10	Flashing
b. R1		X7373
c. R3		00030

6.2.21.3.5 Insert in K148

a. V 33 ENTER

6.2.21.3.6 Observe on CRT

a. V 01	NOUN 10	Flashing
b. R1		37777
c. R3		00031

6.2.21.3.7 Insert in K148

a. V 33 ENTER

6.2.21.3.8 Observe on CRT

a. V 33	N 03	Flashing
b. R1		+00385
c. R2		-00385
d. R3		+00003

6.2.2.3.9 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+16.88 ±1.00 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-16.88 ±1.00 degrees

6.2.21.3.10 Insert in K148

a. VERB 33, ENTER

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6.2.21.3.11 Observe on CRT

a. V 33	N 03	Flashing
b. R1		+00384
c. R2		-00384
d. R3		+00003
e. NO ATT		OFF

6.2.21.3.12 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+16.88 ±1.00 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-16.88 ±1.00 degrees

6.2.21.3.13 Insert in K148

a. VERB 33, ENTER

6.2.21.3.14 Observe on CRT

a. V 33	N 03	Flashing
b. R1		+00160
c. R2		-00160
d. R3		+00003

6.2.21.3.15 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+6.95 ±0.41 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-6.95 ±0.41 degrees

6.2.21.3.16 Insert in K148

a. VERB 33, ENTER

6.2.21.3.17 Observe on CRT

a. V 33	N 03	Flashing
b. R1		+00135
c. R2		-00135
d. R3		+00003

6.2.21.3.18 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+5.88 ±0.35 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-5.88 ±0.35 degrees

6.2.21.3.19 Insert in K148

a. VERB 33, ENTER

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6.2.21.3.20 Observe on CRT

a.	V 33	N 03	Flashing
b.	R1		+00090
c.	R2		-00090
d.	R3		+00003

6.2.21.3.21 Record CRT indications

a.	CG 3722	TRUNNION CDU DAC OUTPUT	+3.93 ±0.24 degrees
b.	CG 3721	SHAFT CDU DAC OUTPUT	-3.93 ±0.24 degrees

6.2.21.3.22 Set the OPTICS CONTROLLER SPEED Switch on the Indicator Control panel to HI.

6.2.21.3.23 Insert in K148

a. VERB 33, ENTER

6.2.21.3.24 Observe on CRT

a.	V 33	N 03	Flashing
b.	R1		+00000
c.	R2		+00000
d.	R3		+00003

6.2.21.3.25 While holding the Optics Hand Controller up and left (45°) no longer than 10 seconds, record CRT indications.

a.	CG 3722	TRUNNION CDU DAC OUTPUT	0.00 ±0.19 degrees
b.	CG 3721	SHAFT CDU DAC OUTPUT	0.00 ±0.19 degrees

6.2.21.3.26 Insert in K148

a. VERB 33, ENTER

6.2.21.3.27 Observe on CRT

a.	V 33	N 03	Flashing
b.	R1		-00090
c.	R2		+00090
d.	R3		+00003

6.2.21.3.28 Record CRT indications

a.	CG 3722	TRUNNION CDU DAC OUTPUT	-3.93 ± .24 degrees
b.	CG 3721	SHAFT CDU DAC OUTPUT	+3.93 ± .24 degrees

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6.2.21.3.29 Set the OPTICS MODE Switch on the Indicator Control panel to ZERO for 30 seconds, then return to MAN.

6.2.21.3.30 Insert in K148

a. VERB 33, ENTER

6.2.21.3.31 Observe on CRT

a. V 33	N 03	Flashing
b. R1		-00135
c. R2		+00135
d. R3		+00003

6.2.21.3.32 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-5.88 ±0.35 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	+5.88 ±0.35 degrees

6.2.21.3.33 Insert in K148

a. VERB 33, ENTER

6.2.21.3.34 Observe on CRT

a. V 33	N 03	Flashing
b. R1		-00160
c. R2		+00160
d. R3		+00003

6.2.21.3.35 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-6.95 ±0.41 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	+6.95 ±0.41 degrees

6.2.21.3.36 Insert in K148

a. VERB 33, ENTER

6.2.21.3.37 Observe on CRT

a. V 33	N 03	Flashing
b. R1		-00384
c. R2		+00384
d. R3		+00003

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6.2.21.3.38 Record CRT indications

a.	CG 3722	TRUNNION CDU DAC OUTPUT	-16.88 ±1.00 degrees
b.	CG 3721	SHAFT CDU DAC OUTPUT	+16.88 ±1.00 degrees

6.2.21.3.39 Insert in K148

a. VERB 33, ENTER

6.2.21.3.40 Observe on CRT

a.	V 33	N 03	Flashing
b.	R1		-00385
c.	R2		+00305
d.	R3		+00003

6.2.21.3.41 Record CRT indications

a.	CG 3722	TRUNNION CDU DAC OUTPUT	-16.88 ±1.00 degrees
b.	CG 3721	SHAFT CDU DAC OUTPUT	+16.88 ±1.00 degrees

6.2.21.3.42 Insert in K148

a.	V 34		ENTER
b.	V 40	N 20	ENTER
c.	V 41	N 20	ENTER
d.	+00000		ENTER
e.	+00000		ENTER
f.	+00000		ENTER

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APPENDIX I

<u>Signal</u>	<u>Nomenclature</u>	<u>G&N Test Requirement</u>	<u>PSAAM and/or SCA Uncertainty % of Full Scale</u>
CG 1020	+14 VDC CMC SUPPLY	+14.0 ± 0.4 VDC	0%
CG 1030	+4 VDC CMC SUPPLY	+4.00 ± 0.2 VDC	0%
CG 1040	+120 VDC PIPA SUPPLY	+120 ± 6.0 VDC	1%
CG 1051	+20 VDC PIPA SUPPLY	+20.0 ± 1.2 VDC	0%
CG 1052	-20 VDC PIPA SUPPLY	-20 ± 2 VDC	0%
CG 1070	+4 VDC CDU SUPPLY	+4.0 ± 0.2 VDC	0%
CG 1100	-28 VDC SUPPLY	-27.5 ± 6.0 VDC	0%
CG 1110	2.5 VDC TM BIAS	+2.5 ± 0.05 VDC	0%
CG 1201	IMU 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	1%
CG 1202	IMU 28V .8 KC 5% - 90° RMS	28.0 ± 1.4 VRMS	1.5%
CG 1203	IMU 28V .8KC 0° RMS	28.0 ± 2.1 VRMS	1.5%
CG 1207	PH DIFF IMU 5% 0°, -90°	90 ± 10°	3%
CG 1211	OPTX 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	1.5%
CG 1212	OPTX 28V .8KC 5% -90° RMS	28.00 ± 1.48 VRMS	1.5%
CG 1220	PH DIFF OPTX 1% IMU 1%	0° ± 10°	3%
CG 1331	3.2 KC 28V SUPPLY	28.6 ± 0.56 VRMS	1%
CG 1336	PH DIFF 3.2 KC 28V/CMC SYNC	0° ± 10°	3%
CG 1500	+28 VDC IMU OPERATE BUS	28.8 ± 3VDC	0%
CG 1510	+28 VDC IMU STANDBY BUS	28.8 ± 3 VDC	0%
CG 1520	+28 VDC CMC OPERATE BUS	28.8 ± 3 VDC	0%
CG 1530	+28 VDC OPTX OPERATE BUS	28.8 ± 3 VDC	0%
CG 2001	X PIPA SG O/P	5 VRMS max	3%
CG 2021	Y PIPA SG O/P	5 VRMS max	3%
CG 2041	Z PIPA SG O/P	5 VRMS max	3%
CG 2108	IG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2112	IG 1X RESOLVER O/P SIN	(18.38 ± 1.34) 19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2113	IG 1X RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2117	IG SERVO ERROR IN PHASE	0.0 ± 60mv RMS @ null	2%
CG 2120	IG TORQUE MOTOR CURRENT	0.125 amp max during Fine Alignment Torquing	2%
CG 2138	MG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2142	MG 1X RESOLVER O/P SIN	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2143	MG 1X RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2147	MG SERVO ERROR IN PHASE	0.0 ± 60 mv rms @ null	2%
CG 2150	MG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	2%
CG 2168	OG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2172	OG 1X RESOLVER O/P SIN	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2173	OG 1X RESOLVER C/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2177	OG SERVO ERROR IN PHASE	0.0 ± 60mv VRMS @ null	2%
CG 2180	OG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	2%

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<u>Signal</u>	<u>Nomenclature</u>	<u>G&N Test Requirement</u>	<u>PSAAM and/or SCA Uncertainty % of Full Scale</u>
CG 2219	PITCH ATT ERROR - CDU DAC C/P	5.06 ± 0.5 VRMS @ 17°	2%
CG 2220	IG CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 2221	IG CDU COARSE ERROR	0.0 ± 0.68 VRMS @null	1%
CG 2249	YAW ATT ERROR-CDU DAC C/P	5.06 ± 0.5VRMS @ 17°	2%
CG 2250	MG CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 2251	MG CDU COARSE ERROR	0.0 ± 0.68VRMS @ null	1%
CG 2279	ROLL ATT ERROR-CDU DAC C/P	5.06 ± 0.5VRMS @17°	2%
CG 2280	OG CDU FINE ERROR	0.0 ± 0.07 VRMS 2 null	1%
CG 2281	OG CDU COARSE ERROR	0.0 ± 0.68 VRMS	1%
CG 2300	PIPA TEMPERATURE	130 ± 1.5°F Operate Mode	0%
CG 3011	TRUNNION CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 3021	SHAFT CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 3117	SXT SHAFT SERVO ERROR IN PH	2 VRMS max	2%
CG 3118	SXT TRUNNION SERVO ERROR IN PHASE	2 VRMS max	2%
CG 3140	SXT SHAFT TACH C/P	3.1 ± 1.1VRMS @ Hi Rate	2%
CG 3145	SXT SHAFT MIR CONTROL WINDING	3.3 ± 1.3VRMS @ Hi Rate	2%
CG 3150	SXT TRUNNION TACH C/P	3.3 ± 1.3VRMS @ Hi Rate	2%
CG 3155	SXT TRUNNION MIR CONTROL WINDING	0.85 ± 0.35VRMS at Hi Rate	2%
CG 3160	SXT SHAFT TACH C/P	3.3 ± 1.3 VRMS @ Hi Rate	2%
CG 3170	SXT TRUNNION TACH C/P	0.85 ± 0.35VRMS @Hi Rate	2%
CG 3721	SHAFT CDU DAC C/P	5.06 ± 0.50VRMS @17°	1%
CG 3722	TRUNNION CDU DAC C/P	5.06 ± 0.50VRMS @ 17°	1%
CG 4300	CMC TEMP	75 ± 45°F	0%
CG 6020	PIPA CAL MODULE TEMP	57.5 ± 27.5°F	0%
CG 6021	IMU 800 cps % TEMP (PSA)	57.5 ± 27.5°F	0%
CG 2301	IRIG TEMPERATURE	135 ± 2.5°F in Operate	0%

All uncertainties specified above and those due to instrumentation in the ACE equipment shall be root sum squared with the basic system tolerances to yield an acceptable tolerance for use when testing the G&N System in the spacecraft.

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ADDENDUM I

Scope: The following changes are required to make ND1002325 applicable as G&N System technical support documentation for CSM 101.

Addition 1: Page 50 paragraph 6.2.7.2.6. Add the following:
During this 12 minute period monitor IG TORQUE MOTOR CURRENT (CG 2120) on the CRT. This measurement shall not exceed 0.125 amp.

Addition 2: Page 51 paragraph 6.2.7.3.5. Add the following:
During this 12 minute period monitor OG TORQUE MOTOR CURRENT (CG 2180) on the CRT. This measurement shall not exceed 0.125 amp.

Addition 3: Page 53, paragraph 6.2.7.4.5. Add the following:
During this 5 minute period monitor MG TORQUE MOTOR CURRENT (CG 2150) on the CRT. This measurement shall not exceed 0.125 amp.

Addition 4: Page 41. Add 6.2.4.14 On the Event Recorder verify that the IMU HTR CURRENT (CG 2302) discrete and IMU BLOWER CURRENT (CG 2303) discrete are cycling on and off.

Addition 5: Page 71 paragraph 6.2.13.6 Add the following step prior to 6.2.13.6:
During the Trunnion Slew Rate Test HI Speed (6.2.13.6) monitor and verify the following signals on the CRT.

Signal	Requirement
a. TRUNNION CDU FINE ERROR (CG 3011)	±.07 VRMS Max.
b. SXT TRUNNION TACH O/P (CG 3150)	3.3 ± 1.3 VRMS
c. SCT TRUNNION TACH O/P (CG 3170)	0.85 ± 0.35 VRMS

Addition 6: Page 72 paragraph 6.2.13.9. Add the following step prior to 6.2.13.9:
During the Shaft Slew Rate Test - HI speed (6.2.13.9) monitor and verify the following signals on the CRT.

Signal	Requirement
a. SHAFT CDU FINE ERROR (CG 3021)	±.07 VRMS Max.
b. SXT SHAFT TACH O/P (CG 3140)	3.3 ± 1.3 VRMS
c. SCT SHAFT TACH O/P (CG 3160)	3.3 ± 1.3 VRMS

Addition 7: Page 16 paragraph 6.1.2.1 Add new paragraph 6.1.2.1.5 as follows:
Data from the on board tape recorder shall be made available and the following signals verified.

- a. VIB NG ROLL (CG 6001)
- b. VIB NB PITCH (CG 6002)
- c. VIB NB YAW (CG 6003)

APOLLO G&N Specification
MD 1002325 .B

Original Issue Date:

Release Authority: TDRR 31414

Class A Release

POST INSTALLATION CHECKOUT PROCESS
SPECIFICATION FOR THE APOLLO GUIDANCE
AND NAVIGATION SYSTEM -- BLOCK II

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
11/1/66	A	31785	1-116 was 116 pages, now 118 pages.	EA	WLS
1/26/67	B	32784	2, 3, 6, 9, 11, 15, 16, 24, 27, 29, 34, 39	EA	—
			44-50, 54, 56-59, 61-65, 67, 68, 72-74, 76-79, 81-103, 106-117;		
			was 118 pages, now 119 pages.		

This specification consists of page 1 to 119 including Appendix I pages 116, 117 and Addendum I, page 118 and Addendum II, page 119.

APPROVALS	NOT REQUIRED PER CCA-497-0274 NASA/MSC				ACED
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1. INTRODUCTION

- 1.1 The individual Spacecraft (SC) installed Guidance and Navigation (G&N) System to be checked out per this process specification shall consist of one of each of the following major assemblies: The applicable part numbers shall be determined by drawing No. 2014999.

- 1 - Optical Unit Assembly
- 1 - Navigation Base Assembly, Block II
- 1 - Inertial Measurement Unit (IMU) & PIPA Elect. Assy.
- 1 - Power and Servo Assembly (PSA)
- 1 - Apollo Guidance Computer Group
- 1 - G&N Interconnect Harness Assembly
- 1 - Signal Conditioner Assembly
- 1 - Display and Control Group (D & C)
- 1 - Coupling Data Unit

- 1.2 The G&N System herein shall be identified as a Block II system. The computer contains the SUNDIAL D program test ropes in the core rope memory.

2. SCOPE

- 2.1 This specification outlines the checkout requirements for the G&N System installed in the Apollo Command Module Spacecrafts.

- 2.2 This document is to be used as technical support for all Block II G&N System test documentation for Command Module spacecraft testing. This document shall be amended by addendum to support applicable hardware, mission, or program differences.

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3. APPLICABLE DOCUMENT

3.1 Documents Required by This Specification

3.1.1 When the requirements of this specification conflict with the drawing requirements, the drawing requirements shall have precedence.

PS 2015000	Master End Item Specification, Part II, Product Configuration and Acceptance Test Requirements, G&N Spacecraft Equipment Command Module, Block II
ICD MH01-01307-216	CDU to TVC Servo Amps Electrical Block II
ICD MH01-01324-216	Attitude Error Signals Electrical Block II
ICD MH01-01325-216	Total Attitude Signals
ICD MH01-01327-216	G&N Electrical Input Power
ICD MH01-01328-216	G&N Data Transmission to Operational and Flight Qual. Telemetry
ICD MH01-01342-216	G&N System Caution and Warning System Interface
ICD MH01-01349-416	G&N Thermal Requirements for Block II AGE
ICD MH01-01344-216	Mode Control Signals S/C to ISS Discretes
ICD MH01-01335-200	Electrical Inertial Temperature Controller
ICD MH01-01380-216	Command Module Guidance Computer Electrical Interfaces Block II
ICD MH01-01386-216	Attitude Error to SIVB
MH01-01390-200	G&N PSA Adapter Module ACE-S/C DTMS and DTCS Block II Vehicles.
MA0201-5108	ACE-S/C Computer Subprogram Program Requirements 2TV1, NAA
MA0308-0107	Mechanical Installation Specification for Apollo Guidance Equipment 2TV1
MA0610-018A	Contamination Control - Apollo Command Module and Service Module
SID 65-1642	Apollo Command Module/Service Module Measurement Requirements for Block II

3.1.2 The following addendums are applicable to this document.

- a. Addendum I CSM 101
- b. Addendum II SUNDIAL C

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- 5.1.2.5 Failure of the G&N System to pass any examination or test specified herein shall tentatively classify the G&N System as nonconforming. The normal test sequence may be continued on determination of the cause of the nonconformance if not detrimental to the G&N System on other interfacing subsystems. This determination shall have the concurrence of the G&N contractor test team. All nonconformance shall be investigated and cleared by waiver (FNN), correction of test specification, or hardware replacement. The suspected malfunctioning hardware shall be removed and returned to the laboratory, where the malfunction shall be verified. Only after malfunction verification shall a flight certified replaceable unit be installed in the G&N System.
- 5.1.2.6 The G&N System shall be operating in STANDBY mode with G&N power applied for a minimum of two hours prior to torquing of inertial components. In the event STANDBY or G&N power is interrupted, an equivalent time period shall be allowed when power is restored before transfer to the OPERATE mode, except that when the interval of interruption exceeds two hours, a two-hour warmup period shall be mandatory. Exceptions to the above are noted in 6.2.5.2.
- 5.1.2.7 The interruption of +28 VDC power to the G&N System through the Main A and Main B power busses shall be cause for the Command Module G&N System operator to immediately initiate the Emergency shutdown procedure (6.1.4) to preclude damage to the G&N System.
- 5.1.2.8 The SCT and SXT eyepieces shall be stowed whenever the instruments are not in use to preclude damage to them. It shall be necessary to install the eyepieces when testing requires use of the instrument.
- 5.1.2.9 To preserve the operational life of the components of the MDC and LEB DSKY's, the monitor routines shall be used only when required by test procedure or troubleshooting. Such routines shall be terminated as quickly as possible in the test flow. Computer routines which cause the DSKY display to flash (either requesting data or displaying data) shall also be terminated as quickly as possible.

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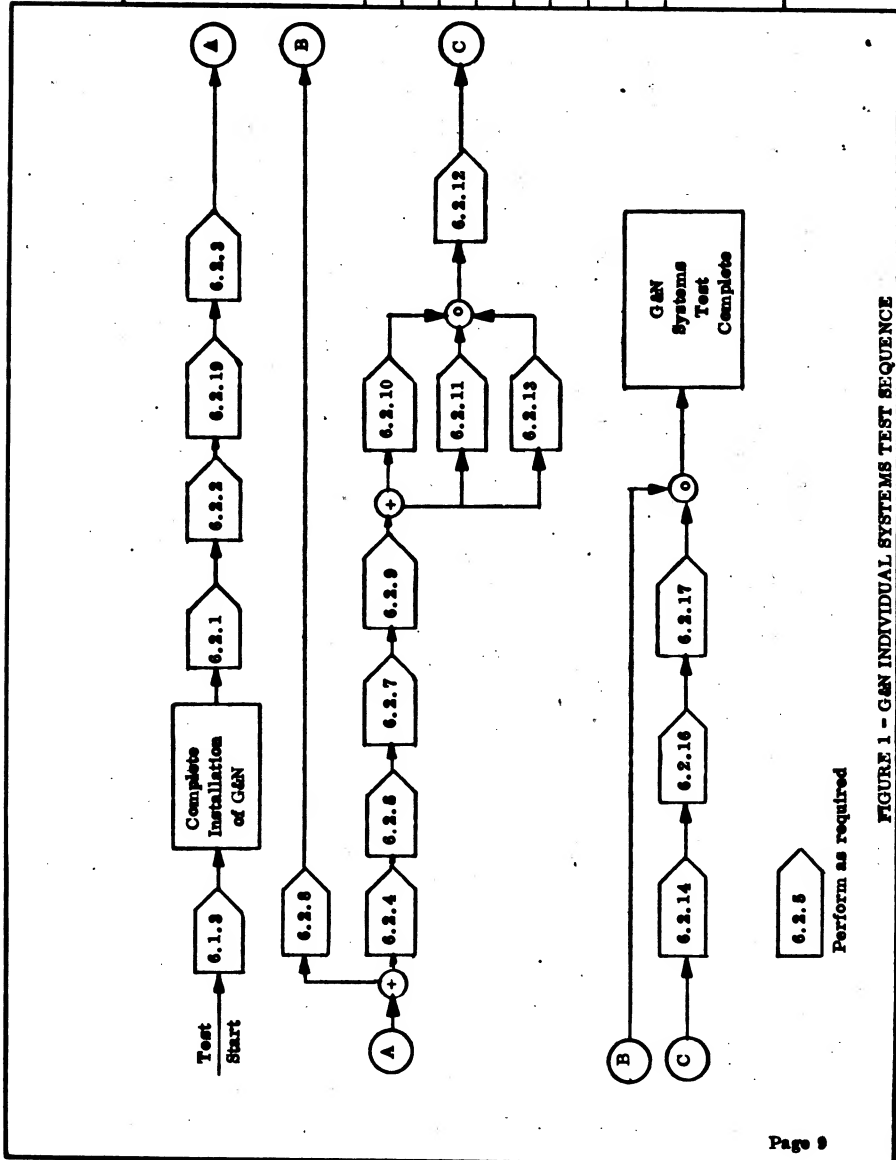


FIGURE 1 - G&N INDIVIDUAL SYSTEMS TEST SEQUENCE

Perform as required

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Paragraph Number		Test Title	RETEST SEQUENCE												
			IMU	NAV BASE	OPTICS	CMC	PSA	LEB DSKY	MDC DSKY	SIGN COND	CDU	G&N HARNESS	PIPA ELECT.	INDICATOR CONTROL PANEL	
6.1.3		Pre-Power Application Tests	X	X	X	X	X	X	X	X	X	X	X	X	
6.2.1		Application of Standby Power to G&N System	X	X		X	X	X	X	X	X	X	X		
6.2.5		General Turn OFF and Turn ON Procedure	*	*	*	*	*	*	*	*	*	*	*	*	
6.2.3		Operate Power On Test	X	X		X	X	X	X	X	X	X	X		
6.2.2		CMC Operational Test				X	X	X	X	X	X	X	X	X	
6.2.8		G&N Panel Brightness and Lamp Test	X	X	X	X	X	X	X	X	X	X	X	X	
6.2.6		G&N Operational Test	X	X	X	X	X	X	X	X	X	X	X	X	
6.2.10		Zero Optics Test		X	X	X	X	X	X	X	X	X	X	X	
6.2.13		Optics Slew Rate Test		X	X	X	X	X	X	X	X	X	X	X	
6.2.11		Optics Coordinate Transformation Control		X	X	X	X	X	X	X	X	X	X	X	
6.2.12		Optics Positional Accuracy Test		X	X	X	X	X	X	X	X	X	X	X	
6.2.9		Semi-Automatic Mode Control Test	X	X	X	X	X	X	X	X	X	X	X	X	
6.2.14		Stab Loop Step Response Test	X	X	X	X	X	X	X	X	X	X	X	X	
6.2.15		IRIG Scale Factor Test	X	X	X	X	X	X	X	X	X	X	X	X	
6.2.16		IMU Performance Test	X	X	X	X	X	X	X	X	X	X	X	X	
6.2.17		Fine Alignment Test	X	X	X	X	X	X	X	X	X	X	X	X	
6.2.19		Voltage Margin Test	X	X	X	X	X	X	X	X	X	X	X	X	
6.2.7		Gimbal Friction Test	X	X											
6.2.18		Gyrocompassing Test**	X	X											
6.2.4		G&N Power Supplies Test	X	X			X	X	X	X	X	X	X	X	
6.2.21		Spacecraft Control and Displays Test				X									

* To be used as necessary to turn system on and off.

** If the Gyrocompassing Test is performed as part of a retest activity, it shall be performed for a total of 5 hours including the 2 hour settling period.

* To be used as necessary to turn system on and off.

** If the Gyrocompassing Test is performed as part of a retest activity, it shall be performed for a total of 5 hours including the 2 hour settling period.

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- 6.1.1.5 A warmup period of 1 hour with OPERATE power applied shall be required prior to performing any test in which gyre and accelerometer parameters are measured, and 15 minutes warmup prior to any test in which precision amplitude and frequency power supply checks are made.
- 6.1.1.6 The following Command Module switches shall be in the position shown unless specifically directed otherwise in a procedural function.
- UP TLM switches on the LEB G&N Central Panel and MDC Panel 2 shall be set to ACCEPT.
 - LAUNCH VEHICLE - GUIDANCE switch on MDC Panel 2 shall be set to IU.
 - The SC COMF switch on MDC Panel 1 shall be set to CMC.
 - The CMC MODE switch on MDC Panel 1 shall be set to AUTO.
 - The ΔV CG switch on MDC Panel 1 shall be set to CSM.
 - The TRACKER switch on G&N Indicator Central Panel shall be set to OFF.
 - The LIGHTS-INTEGRAL control on the LEB Lighting Central Panel and the Left Hand Circuit Breaker panel shall be set to the minimum brightness - OFF position.
- 6.1.2 The following optical reference alignment requirements shall be demonstrated.
- 6.1.2.1 G&N Installation Qualification Fixture
- 6.1.2.1.1 The SXT Optical Reference No. 1 (Azimuth Autoset) LOS shall be located approximately 40 degrees (CW when viewed from above) from the SZ axis measured in a horizontal plane. At this position, the Optical Reference shall be capable of being viewed through the SXT SF LOS.
- 6.1.2.1.2 The SXT Optical Reference LOS position with respect to the horizontal plane shall be known to within 5 arc-seconds. The azimuth bearing of the Optical Reference LOS shall be known to within ± 30 minutes of arc.
- 6.1.2.1.3 The SXT Optical Reference No. 2 LOS shall be located approximately 80 degrees from the SXT Optical Reference No. 1 (40 degrees from S/C Z axis) measured in a horizontal plane. At this position, the Optical Reference shall be capable of being viewed through the SXT STAR LOS.

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- 6.1.2.1.3.1 The SXT optical reference LOS position with respect to the horizontal plane shall be known to within 5 arc-seconds. The SXT optical reference No. 1 and No. 2 shall be known to within 100 seconds of arc.
- 6.1.2.1.4 SXT Optical Reference No. 3 shall be capable of being viewed through the SXT LOS and the SEAR LOS simultaneously at the Zero Optics position.
- 6.1.2.1.4.1 SXT Optical Reference No. 3 shall have the capability to measure the nonparallelism of the LOS and SEAR LOS to a resolution of 2 arc-seconds.

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6.2.1.4.9 Zero the CMC erasable memory by entering the following sequence into the K-start:

- a. VERB 57, ENTER
- b. 00015, ENTER

6.2.1.4.10 Initiate CMC self-check by entering the following sequence into the K-start:

- a. VERB 21, NOUN 27 ENTER
- b. 77777, ENTER
- c. VERB 15 NOUN 01 ENTER
- d. 1366, ENTER

6.2.1.4.10.1 Monitor DSKY until R3 (SCOUNT +2) increments twice. If an error is detected, the following will be displayed:

R1 = 01102
R2 = XXXXX C (SFALL)
R3 = XXXXX C (ERCOUNT)

6.2.1.4.10.2 Enter the following into the K-start:

- a. VERB 21
- b. NOUN 27, press ENTER pushbutton
- c. 00000, press ENTER pushbutton

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6.2.2.3 CAUTION and STATUS Displays

6.2.2.3.1 Enter VERB 35, ENTER, into LEB CMC DSKY.

6.2.2.3.2 The following MDC and LEB CMC DSKY displays shall illuminate for approximately 5 seconds.

- a. UPLINK ACTY
- b. NO ATT
- c. STBY
- d. KEY REL Flashing
- e. TEMP
- f. GIMBAL LOCK
- g. PROG
- h. RESTART
- i. TRACKER
- j. OPR ERROR Flashing
- k. COMP ACTY
- l. VERB-NOUN Flashing
- m. Plus 88888 in R1, R2, and R3
- n. PGNS, CMC, and ISS caution lights. (CMC caution shall remain illuminated for approximately 60 seconds.)

After indications a through l go out +88888 shall remain in R1, R2, R3.

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6.2.2.5 Uplink and Downlink Checks.

6.2.2.5.1 Enter VERB 36 into K148. Press the ENTER pushbutton, then press ERROR RESET pushbutton.

6.2.2.5.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.

- a. VERB 25 NOUN 01 ENTER
- b. 01600, ENTER
- c. 00000, ENTER
- d. 77777, ENTER
- e. 07254, ENTER
- f. VERB 05 NOUN 01, ENTER
- g. 01600, ENTER

6.2.2.5.3 CMC Registers R1, R2, and R3 display on the CRT shall indicate 00000, 77777, and 07254, respectively.

6.2.2.6 CMC Automatic Self-Test

6.2.2.6.1 Initiate CMC Self-Test by entering the following sequence into the K-Start.

- a. VERB 21 NOUN 27, ENTER
- b. 77777, ENTER
- c. VERB 15 NOUN 01, ENTER
- d. 1366, ENTER

6.2.2.6.2 Monitor DSKY until R3 (SCOUNT+2) increments twice. If an error is detected, the following will be displayed.

- a. VERB 05 NOUN 31
- b. R1 = 01102
- c. R2 = XXXXX c (SFAIL)
- d. R3 = XXXXX c (ERCOUNT)

6.2.2.6.3 Terminate Self-Test by entering the following into the K-Start.

- a. VERB 21 NOUN 27, ENTER
- b. 00000, ENTER

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6.2.2.11 CMC Clock Frequency Test

6.2.2.11.1 Insure that the CMC has been operating for at least 15 min. before performing this test.

6.2.2.11.2 Insure that the IMU 3.2 kc 28 V Supply is available on the vertical input to FIPA Scope.

6.2.2.11.3 Insure that the EPUT Meter and preset counter plug-in unit are connected to 115V, 60 cps power.

6.2.2.11.3.1 Permit the EPUT to warm up for the length of time required by the manufacturer's specification.

6.2.2.11.4 Connect the signal output from Oscilloscope 4A4-A1 to the input channel on the EPUT Meter.

6.2.2.11.5 Set the preset counter to indicate 96000.

6.2.2.11.6 Set the EPUT meter to count at the maximum count rate (1 megacycle or greater).

6.2.2.11.7 Adjust the Trigger Level to the point midway between the range over which the counter will normally count.

6.2.2.11.8 Each count cycle shall last approximately 30 seconds. Adjust the display time to permit recording the display on the EPUT.

6.2.2.11.9 Record the results of 10 count-cycles. Calculate the average time per cycle over the 10 cycles. Record the result.

6.2.2.11.10 Divide 96000 by the average time from 6.2.2.11.9. Record the result as 3200 cps frequency.

6.2.2.11.11 Multiply the 3200 cps frequency by 640. Record the result as the CMC clock frequency.

6.2.2.11.11.1 The CMC Clock Frequency shall be 2048000 ± 5 cps.

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6.2.4 G & N System Power Supplies Test

6.2.4.1 Proceed with this test if 6.2.3, Operate Power On Test, has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding with this test. Insure that the IMU Operate Power has been on for at least 15 minutes before proceeding with this test.

6.2.4.2 Enter the following sequence into the K-Start. Verb 41 NOUN 20, ENTER; +00000 ENTER; +00000 ENTER, +00000 ENTER.

6.2.4.3 Insure that OPERATE power has been applied for at least 15 minutes. Verify that the discretes listed below have been issued by noting that the event lamps on the specified Event Module are illuminated.

- a. IMU STANDBY POWER (CG 1513)
- b. CMC OPERATE POWER (CG 1523)
- c. OPTX OPERATE POWER (CG 1533)

6.2.4.4 The IRIG and PIPA Pulse Torque DC supply shall demonstrate the following requirements. The DC output voltages shall be as follows. Record the indicated voltages on the CRT.

- a. The 120 volt PIPA Power Supply output voltage shall be 120 ± 6 VDC (CG 1040).
- b. The PIPA +20 VDC Supply output voltage shall be $+20 \pm 1.2$ VDC (CG 1051).
- c. The PIPA -20 VDC output voltage shall be -20 ± 2 VDC (CG 1052).

6.2.4.5 The minus 28 VDC Electronics Power Supply output voltage shall be -27.5 ± 6.0 VDC (CG 1100). Record the indicated voltage displayed on the CRT.

6.2.4.6 Power Supplies

Record the indicated voltage display on the CRT.

- a. The +14 VDC CMC Power output voltage shall be $+14.0 \pm 0.4$ VDC (CG 1020).
- b. The +4 VDC CMC Power Supply output voltage shall be $+4.00 \pm 0.29$ VDC (CG 1030).
- c. The +4 VDC CDU Power Supply output voltage shall be $\pm 4.0 \pm 0.2$ VDC.
- d. The +2.50 TM BIAS Supply output voltage shall be 2.50 ± 0.05 vdc (CG 1110).

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- 6.2.5.2.3 Energize the G&N IMU HTR, MN A and MN B breakers on the Right Hand Circuit Breaker panel (breakers pushed in).
- 6.2.5.2.4 Energize the G&N COMPUTER MN A and MN B breakers on the Right Hand Circuit Breaker panel (breakers pushed in). If the STBY indicator on the DSKY is illuminated, press the STBY pushbutton for approximately 3 seconds until the STBY indicator extinguishes. Enter VERB 61 into K148 and press the ENTER pushbutton. Insure that the CMC +28 VDC discrete lamp on the Event Module is illuminated (CG 1523). Verify +14 and +4 VDC AGC power supply outputs on CRT display. Voltages shall be +14±0.4V (CG 1020) and +4±0.2 (CG 1030).
- 6.2.5.2.5 Set the G&N POWER AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in). Set the G&N POWER AC1-OFF-AC2 switch to AC1.
- 6.2.5.2.5.1 Set the G&N DSKY and Display Panel brightness to the minimum a acceptable level by manipulation of LIGHTS - NUMERICS control on both Left Hand circuit breaker panel and LEB light Control panel.
- 6.2.5.2.6 Disregard all alarm indication on the CMC DSKY panels. Enter VERB 36 into K148. Press ENTER pushbutton. Press ERROR RESET pushbuttons on K-Start. All computer alarms except the Gimbal Lock Indicator on the Main Display Console (MDC) and LEB AGC DSKY shall clear. Verify registers R1, R2, and R3 on the DSKY's are cleared.
- 6.2.5.2.7 Clear the CMC erasable memory by entering the following sequence into the K-Start. a. VERB 57, press ENTER
b. 00015, press ENTER
- 6.2.5.2.8 Initiate CMC Self-Test by entering the following into the K-Start:
a. VERB 21 NOUN 27, ENTER
b. 77777, ENTER
c. VERB 15 NOUN 01, ENTER
d. 01366, ENTER
- 6.2.5.2.8.1 Monitor DSKY until R3 (SCOUNT+2) increments twice. If an error is detected, the following will be displayed:
a. VERB 05 NOUN 31
b. R1 = 01102
c. R2 = XXXXX c (SFAIL)
d. R3 = XXXXX c (ERCOUNT)
- 6.2.5.2.8.2 Terminate Self-Test by entering the following into the K-Start.
a. VERB 21 NOUN 27, ENTER
b. 00000, ENTER

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6.2.5.2.8 Enter the following into the Keystart:

- a. VERT B
1. NGUN 27 ENTER
- c. 00000, ENTER

NOTE: Allow 2 hours to elapse before proceeding to 6.2.5.2.9 with the following exceptions:

- a. If the G&N System has been in the power off state for less than 5 days with the gimbals in the parked position (0°, 0°, 90°) and the system has not been moved, allow 15 minutes to elapse before proceeding.
- b. If the G&N System has been turned off for less than 15 minutes allow 90 seconds to elapse before proceeding.
- c. If the G&N System has been turned off with the gimbals in the unparked position for more than 15 minutes but less than 2 hours allow a warmup time equal to the time off to elapse before proceeding.

CAUTION: If the requirements of 6.2.5.2.10 are not met, remove IMU Operate Power immediately by setting the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

6.2.5.2.9 After the required warmup time has elapsed set the G&N IMU MN A and MN B circuit breaker on the Right Hand circuit breaker panel to ON (breaker pushed in), and the G/N POWER - IMU switch on the LEB Lighting Control panel to the ON position (toggle up).

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- 6.2.5.2.10** Immediately begin monitoring the following measurements.
- On the CRT verify that IMU Operate Power is $\pm 28.8 \pm 3$ VDC (CG 1500).
 - On the meter modules verify that oscillations are not sustained and that a null is achieved within 10 seconds of power application on the following measurements:
 - CG 2112 IG 1X Resolver Output Sin
 - CG 2142 MG 1X Resolver Output Sin
 - CG 2172 OG 1X Resolver Output Sin
 - On the CRT verify the absence of the +120 VDC PIPA Supply (CG 1040) for a period of 90 ± 10 seconds following power application. After approximately 100 seconds, the voltage shall read $+120 \pm 6$ VDC.
- 6.2.5.2.11** Verify that the PROGRAM ALARM lamp on the DSKY's does not light with VERB 05 NOUN 31 and R1 = 00213 displayed.
- 6.2.5.2.12** Enter and verify VERB 40, NOUN 20 into K148. Press the ENTER pushbutton.
- 6.2.5.2.13** Enter and verify VERB 41, NOUN 20 into K148. Press the ENTER pushbutton to advance the System to the Coarse Align mode. The VERB-NOUN display on the CRT shall flash and indicate 21-22.
- 6.2.5.2.14** Enter and verify +00000 into K148 three times, pressing the ENTER pushbutton on the K-START after each entry.
- 6.2.5.2.15** Set the G&N OPTICS MN A and MN B circuit breakers on the Right Hand circuit breaker panel to the ON position (breaker pushed in).

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6.2.5.2.16 Verify that the CRT indications of the signals in Table VI are not flashing.

Table VI. Secondary Power Supply Voltages

Measurement Number	Signal
1 CG 1040	+120 VDC PIPA SUPPLY
2 CG 1051	+20 VDC PIPA SUPPLY
3 CG 1052	-20 VDC PIPA SUPPLY
4 CG 1070	+4 VDC CDU SUPPLY
5 CG 1100	-28 VDC ELECTRONICS
6 CG 1020	+14 VDC CMC SUPPLY
7 CG 1030	+4 VDC CMC SUPPLY
8 CG 1201	IMU 28V 800 CPS 1 pct 0 ph
9 CG 1202	IMU 28V 800 CPS 5 pct ph A
10 CG 1203	IMU 28V 800 CPS 5 pct ph B
11 CG 1331	3.2 KC 28V SUPPLY
12 CG 1110	2.5 VDC TM BIAS
13 CG 2300	PIPA TEMPERATURE
14 CG 2301	IRIG TEMPERATURE

6.2.5.2.17 Monitor the PIPA Display Scoops to insure that each PIPA is moding properly.

6.2.5.2.18 Perform 6.2.6 G&N Operational Test.

6.2.6 G&N Operational Test

6.2.6.1 Initial Conditions

Proceed with this test if the Operate Power On Test of 6.2.3 or the Turn On Procedure of 6.2.5 has been completed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding.

6.2.6.1.1 Enter the following into K-148:

- a. VERB 01 NOUN 10, ENTER
- b. 00003, ENTER
- Record R1 = AAAAA and the time of day.

6.2.6.1.2 Enter the following into K-148.

- a. VERB 21 NOUN 02, ENTER
- b. 01300, ENTER
- c. AAAAA, ENTER (from 6.2.6.1.1)
- d. VERB 06 NOUN 02, ENTER
- e. 01300, ENTER
- Record R1 = BBBB

6.2.6.1.3 Perform the following calculations:

- a. $R1 (BBBB) \times 5.12$ = CC.C (hours in high order scaler Channel 03)
3600

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b. 23.3 - CC.C = DD.D hours

c. Add DD.D to the time of day recorded in 6.2.6.1.1. This is the time of day at which the high order scalar, channel 03, will overflow.

Do not enter the G&N Operational test within -0.2 hours of the time of day calculated in step 6.2.6.13c. If the test is in process at this time, unacceptable test results will occur.

6.2.6.2 Initiation

6.2.6.2.1 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.6.2.2 Enter 00004 into K148. Press the ENTER pushbutton.

6.2.6.2.3 Verify that the PROGRAM display on the CRT indicates 07.

Enter VERB 34 into K148 and press the ENTER pushbutton.

NOTE: During this portion of the test the G&N System is exercised through its modes. Any failures will be indicated by the PROGRAM ALARM lamp on the DSKY's lighting with VERB 05 NOUN 31 and R1 = 01411 displayed.

6.2.6.2.4 After approximately 12 minutes, VERB 06, NOUN 66 will flash and the value of the gravity vector in cm/sec^2 shall be displayed in R1 and R2 on the CRT. Record these values.

6.2.6.2.5 R1 contains the first five digits of the gravity vector and R2 contains the last five digits. A decimal point shall be between them. The value for the gravity vector shall be $980.00000 \pm 05.00000 \text{ cm/sec}^2$.

6.2.6.2.6 Enter VERB 33 into K148. Press the ENTER pushbutton.

6.2.6.2.7 When VERB 06 NOUN 66 flashes the value of the horizontal earth rate shall be displayed on R1 and R2 on the CRT. Record these values.

6.2.6.2.8 R1 contains the first five digits of earth rate and R2 contains the last five digits. A decimal point shall be placed between them. R1 shall always to 00000. The horizontal earth rate shall be 00000.83000 ± 0.1000 earth rate units.

6.2.6.3 Test Termination

6.2.6.3.1 Enter VERB 36 into K148. Press the ENTER pushbutton.

6.2.6.3.2 Enter VERB 41, NOUN 20 into K148. Press the ENTER pushbutton.

6.2.6.3.3 Enter +00000 into K148 three times. Press the ENTER pushbutton after each entry.

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6.2.7 Gimbal Friction Test

6.2.7.1 Proceed with this test if 6.2.5.2 or 6.2.3 has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 before proceeding with this test.

6.2.7.2 Inner Gimbal Friction Test

6.2.7.2.1 Enter the following sequence into the K-Start, pushing the ENTER pushbutton after each entry:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.7.2.2 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

- a. CG 2120 IG TORQUE MOTOR CURRENT
- b. CG 2117 IGA SERVO ERROR IN PHASE
- c. CG 2112 IG 1X RESOLVER OUTPUT SIN
- d. CG 2113 IG 1X RESOLVER OUTPUT COS
- e. CG 2220 IGA CDU FINE ERROR
- f. CG 1201 IMU 28V 0.8 KC 1 pct 0 Deg
- g. CG 2300 PIPA TEMPERATURE
- h. CG 2301 IRIG TEMPERATURE

6.2.7.2.3 Enter the following into K148.

- a. VERB 01 NOUN 01, ENTER
- b. 00362, ENTER
- Record R1 = XXXXY

6.2.7.2.4 Enter the following into K148.

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table I and XXXX is that recorded in 6.2.7.2.3.

TABLE I

Y (From 6.2.7.2.3)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.7.2.5 Enter the following sequence into the K-Start, pushing the ENTER pushbutton after each entry (+360 IG torquing)

- a. VERB 24 NOUN 01, ENTER
- b. 00407, ENTER
- c. 40000, ENTER
- d. 40034, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears

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in R3.

- 6.2.7.2.6 Enter the following sequence into K-Start:
- a. VERB 42, press ENTER
 - b. VERB 33, press ENTER (verify VERB 33 on CRT)
- 6.2.7.2.7 Start analog recorders.
- 6.2.7.2.8 Observe measurement CG 2112, IG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.
- 6.2.7.2.9 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.
- a. VERB 40, NOUN 20, press ENTER
 - b. VERB 41, NOUN 20, press ENTER
 - c. +00000, press ENTER
 - d. +00000, press ENTER
 - e. +00000, press ENTER
- 6.2.7.2.10 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 60 seconds before proceeding.
- 6.2.7.2.11 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (~360° IG torquing):
- a. VERB 24 NOUN 01 ENTER
 - b. 00407, ENTER
 - c. 37777, ENTER
 - d. 37743, ENTER
- Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.
- 6.2.7.2.12 Enter the following sequence into K-Start:
- a. VERB 42, press ENTER
 - b. VERB 33, press ENTER (Verify VERB 33 on CRT).
- 6.2.7.2.13 Start analog recorders.
- 6.2.7.2.14 Observe measurement CG 2112, IG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.
- 6.2.7.2.15 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.
- a. VERB 40, NOUN 20, press ENTER
 - b. VERB 41, NOUN 20, press ENTER'
 - c. +00000, press ENTER
 - d. +00000, press ENTER
 - e. +00000, press ENTER
- 6.2.7.2.16 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 60 seconds before proceeding.

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6.2.7.4.9 Enter the following sequence in the K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.4.10 Start analog recorders.

6.2.7.4.11 Observe measurement CG 2143, MG 1X Resolver output SIN, on the analog recorder. When the steady-state condition occurs, with the reading near zero (approximately 5 minutes), stop the recorders.

6.2.7.4.12 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 36, ENTER
- b. VERB 40 NOUN 20, press ENTER
- c. VERB 41 NOUN 20, press ENTER
- d. +00000, press ENTER
- e. +00000, press ENTER
- f. +00000, press ENTER

6.2.7.5 Examine the traces of the recorded measurements for all six phases of this test to detect any sharp discontinuities. Disregard transients of 0.5 second duration or less on the Gimbal Torque motor current traces, and those less than 0.2 second on the CDU fine error measurement traces. The Gimbal Torque motor currents shall not exceed 0.125 amperes.

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6.2.9 Semi-Automatic Moding Check

Proceed with this test if 6.2.2.2.2 or 6.2.4 has been completed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.2.2 before preceeding with this test.

6.2.9.1 Test Initiation

6.2.9.1.1 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG1530) is +28.0±3.0 VDC. Record the indication on the CRT. Verify that OPTX 28V 800 cps 1% oph (CG1211) and OPTX 28V 800 cps 5%-80 ph (CG 1212) are not flashing on the CRT.

6.2.9.1.2 Enter VERB 07 into K148. Press the ENTER pushbutton.

6.2.9.1.3 Enter 00010 into K148. Press the ENTER pushbutton.

6.2.9.1.4 Observe VERB 06 NOUN 01 flashes on the CRT and the PROGRAM display indicates 07.

6.2.9.2 Enter VERB 33 and press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 02 flashing
- b. R1 = +00000 ± 00007
- c. R2 = +00000 ± 00007
- d. R3 = +00000 ± 00007
- e. IG angle = 000 ± 1 deg.
- f. MG angle = 000 ± 1 deg.
- g. OG angle = 000 ± 1 deg.

6.2.9.3 Enter VERB 33 and press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 03 flashing
- b. R1 = +04500 ± 00007
- c. R2 = +04500 ± 00007
- d. R3 = +04500 ± 00007
- e. IG angle = 045 ± 1 deg.
- f. MG angle = 045 ± 1 deg.
- g. OG angle = 045 ± 1 deg.

6.2.9.4 Enter VERB 33 and press the ENTER pushbutton. After approximately 100 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 30 flashing
- b. R1 = 00000 ± 00003
- c. R2 = 00000 ± 00003
- d. R3 = 00000 ± 00003

NOTE: Negative numbers will be displayed in octal complement form, i.e., -00001 = 77776.

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6.2.9.5 Enter VERB 33 into K146. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 05 flashing
- b. R1 = +07100 ± 00007
- c. R2 = +07100 ± 00007
- d. R3 = +07100 ± 00007
- e. IG angle = 071 ± 1 deg.
- f. MG angle = 071 ± 1 deg.
- g. OG angle = 071 ± 1 deg.

The GIMBAL LOCK lamps on the DSKY's shall light.

6.2.9.6 Enter VERB 23 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 06 flashing
- b. R1 = +09000 ± 00007
- c. R2 = +09000 ± 00007
- d. R3 = +09000 ± 00007
- e. IG angle = 090 ± 1 deg.
- f. MG angle = 090 ± 1 deg.
- g. OG angle = 090 ± 1 deg.

6.2.9.7 Enter VERB 83 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 07
- b. R1 = +13500 ± 00007
- c. R2 = +13500 ± 00007
- d. R3 = +13500 ± 00007
- e. IG angle = 135 ± 1 deg.
- f. MG angle = 135 ± 1 deg.
- g. OG angle = 135 ± 1 deg.

6.2.9.8 Enter VERB 83 and press the ENTER pushbutton. After approximately 20 seconds VERB 06 NOUN 10 shall flash. The GIMBAL LOCK lamp shall extinguish on the DSKY's.

6.2.9.9 Enter VERB 33 and press the ENTER pushbutton. After approximately 100 seconds the following data shall be displayed on the CRT.

- a. VERB 05 NOUN 30 flashing
- b. R1 = 00000 ± 00003
- c. R2 = 00000 ± 00003
- d. R3 = 00000 ± 00003

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6.2.9.10 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 12 flashing
- b. R1 = +22500 ± 00007
- c. R2 = +22500 ± 00007
- d. R3 = +22500 ± 00007
- e. IG angle = 225 ± 1 deg.
- f. MG angle = 225 ± 1 deg.
- g. OG angle = 225 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY's shall light.

6.2.9.11 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 13 flashing
- b. R1 = +22500 ± 00007
- c. R2 = +22500 ± 00007
- d. R3 = +31500 ± 00007
- e. IG angle = 225 ± 1 deg.
- f. OG angle = 225 ± 1 deg.
- g. MG angle = 315 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY shall extinguish.

6.2.9.12 Enter VERB 33 and press the ENTER pushbutton. After approximately 100 seconds the following data shall be displayed on the CRT.

- a. VERB 05 NOUN 30 flashing
- b. R1 = 00000 ± 00003
- c. R2 = 00000 ± 00003
- d. R3 = 00000 ± 00003

6.2.9.13 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 15 flashing
- b. R1 = +31500 ± 00007
- c. R2 = +31500 ± 00007
- d. R3 = +31500 ± 00007
- e. IG angle = 315 ± 1 deg.
- f. MG angle = 315 ± 1 deg.
- g. OG angle = 315 ± 1 deg.

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6.2.9.14 Enter VERB 33 and press the ENTER pushbutton. After approximately 100 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 30 flashing
- b. R1 = 00000 ± 00003
- c. R2 = 00000 ± 00003
- d. R3 = 00000 ± 00003

6.2.9.15 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 17 flashing
- b. R1 = +28900 ± 00007
- c. R2 = +28900 ± 00007
- d. R3 = +28900 ± 00007
- e. IG angle = 315 ± 1 deg.
- f. OG angle = 315 ± 1 deg.
- g. MG angle = 289 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY's shall light.

6.2.9.16 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data will be displayed on the CRT.

- a. VERB 06 NOUN 20 flashing
- b. R1 = +00000 ± 00007
- c. R2 = +00000 ± 00007
- d. R3 = +00000 ± 00007
- e. IG angle = 000 ± 1 deg.
- f. MG angle = 000 ± 1 deg.
- g. OG angle = 000 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY's shall extinguish.

6.2.9.17 Enter VERB 33 and press the ENTER pushbutton. After approximately 15 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 66 flashing
- b. R1 = 000xx
- c. R2 = xxxxx

The GIMBAL LOCK lamp on the DSKY's shall light.

Record R1 and R2 as the Middle Gimbal CDU drive rate.
MG rate = $\frac{R1}{R2}$ /sec. The Middle Gimbal CDU drive rate shall be 14 ± 2 /sec.

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- 6.2.9.22 Enter VERB 33 into K148. Press the ENTER pushbutton. VERB 06 NOUN 55 shall flash on the CRT. The ISS WARNING lamp on the Control Indicator Panel shall extinguish. The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be OFF.
- 6.2.9.23 Set the OPTICS MODE switch on the Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to CMC.
- 6.2.9.24 Enter VERB 38 into K-148 and press the ENTER pushbutton. After approximately 25 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 66 flashing
 - b. R1 = 000xx
 - c. R2 = xxxxx
- Record R1 and R2 as the Shaft Optics CDU drive rate.
 $\text{Shaft rate} = \frac{R1}{R2} \cdot \frac{R2}{R2}$. The Shaft Optics CDU drive rate shall be 7.32 ± 1.63 /sec.
- 6.2.9.25 Enter VERB 33 into K148. Press the ENTER pushbutton. In about 15 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 66
 - b. R1 = 000xx
 - c. R2 = xxxxx
- Record R1 and R2 as the Trunnion Optics CDU drive rate. Trunnion rate = $\frac{R1}{R2} \cdot \frac{R2}{R2}$. The Trunnion Optics CDU drive rate shall be 0.50 ± 0.50 /sec.
- 6.2.9.26 Terminate the Semi-Automatic Moding Check by entering VERB 34 into K148. Press the ENTER pushbutton. Set the G&N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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6.2.10 Zero Optics Test

NOTE: Proceed with this test if 6.2.4 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.2.2 Turn On procedure before proceeding.

- 6.2.10.1 Set the G/N POWER - OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $+28.0 \pm 3.0$ VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.
- 6.2.10.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.
 - a. VERB 41, NOUN 20, ENTER
 - b. +00000, ENTER
 - c. +00000, ENTER
 - d. +00000, ENTER
- 6.2.10.3 Insure that the following switches on the G&N Indicator Control Panel are set as follows:
 - a. TELESCOPE TRUNNION to SLAVE TO SXT
 - b. CONTROLLER COUPLING to DIRECT
 - c. CONTROLLER SPEED to HI
- 6.2.10.4 Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K148. Press the ENTER pushbutton.
- 6.2.10.5 Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following on R1 and R2 of the DSKY.
 - a. $R1 = +000.00 \pm 000.03$ (Shaft Angle)
 - b. $R2 = +00.000 \pm 00.006$ (Trunnion LOS Angle)
 Return the OPTICS MODE switch to MAN.
- 6.2.10.6 Set up the Analog Recorder to monitor the following measurements. Use a chart speed of 10 mm/sec.
 - a. CG 3140 SXT Shaft Tach Output
 - b. CG 3145 SXT Shaft Motor Control Winding
 - c. CG 3150 SXT Trunnion Tach Output
 - d. CG 3155 SXT Trunnion Motor Control Winding
 - e. CG 3160 SCT Shaft Tach Output
 - f. CG 3170 SCT Trunnion Tach Output

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- 6.2.10.7 Push the Optics Hand Controller to the right, driving the SXT Shaft until R1 on the DSKY indicates $+180 \pm 1^\circ$. Push the Optics Hand Controller up, driving the SXT Trunnion until R2 on the DSKY indicates $+75 \pm 1^\circ$.
- 6.2.10.8 Start the Analog Recorders and set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.
- 6.2.10.9 Monitor the Analog Recorders until all signals return to null. Stop the Analog Recorders. The elapsed time between the initial and final SXT Tach output null shall be less than 15 seconds.
- 6.2.10.10 Record R1 and R2 on the CRT. The data displayed shall be as follows:
- a. $R1 = 000.00 \pm 000.03$
 - b. $R2 = 00.000 \pm 00.006$
- Enter VERB 34 and press the ENTER pushbutton.
- 6.2.10.11 Record the Telescope Panel Angle Counter indications. The Shaft Angle shall be 0.0 ± 0.11 degrees. The Trunnion Angle shall be 0.0 ± 0.22 degrees.
- 6.2.10.12 Set the OPTICS MODE switch on the G&N Indicator Control Panel to MAN.

NOTE: If optics testing will not be continued, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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6.2.11 OPTICS Coordinate Transformation Control Test

NOTE: Proceed with this test if 6.2.3 Operate Power on Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding.

6.2.11.1 Set/verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.11.2 Enter the following into the K-Start. Press the ENTER pushbutton after each entry:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.11.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the position indicated.

- a. TELESCOPE TRUNNION to SLAVE TO SXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to HI

6.2.11.4 Set up the analog recorders to monitor the following measurements:

- a. CG 3160 SCT Shaft Tachometer Output
- b. CG 3170 SCT Trunnion Tachometer Output

6.2.11.5 Enter the following into the K-Start to monitor the OPTICS CDU's.

VERB 16 NOUN 55, press ENTER

6.2.11.6 Set the OPTICS MODE switch on the G&N Panel to ZERO. Wait 15 seconds. Insure that the Optics zero properly by observing that R1 and R2 of the CRT indicate as follows:

- a. R1 = +000.00±000.03 (Shaft Angle)
- b. R2 = +00.000±000.06 (Trunnion LOS Angle)

Return the OPTICS MODE switch to MAN.

6.2.11.7 Using the OPTICS CONTROL STICK, drive the Optics until R1 = 225.00 and R2 = 10.000 on the CRT and the DSKY's.

6.2.11.8 Set the CONTROLLER COUPLING switch on the G&N Panel to RSLV and the controller speed switch to MED.

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- 6.2.11.9 Position the movable optics target such that it is centered on the SCT retical pattern, then start the analog recorders at a chart speed of 10 mm/second.
- 6.2.11.10 Quickly displace the OPTICS CONTROL STICK 45 ± 10 degrees in the upper right hand quadrant while sighting on the optics target through the SCT eyepiece. The target shall appear to move in the upper right field of view of the SCT at 45 ± 10 deg. Release the control stick when the target leaves the SCT upper right field of view, and immediately record the shaft angle as displayed on R1 of the CRT and DSKY's. The recorded shaft angle shall be $+225 \pm 10.00$ degrees.
- 6.2.11.11 Enter VERB 34 in the DSKY.
Press the ENTER pushbutton.
- 6.2.11.12 Stop the analog recorder and measure the elapsed time between the initial and the final signal null conditions for the two measurements. The elapsed time shall be 24 ± 6 seconds.
- 6.2.11.13 Set the CONTROLLER COUPLING switch on the G&N Panel to DIRECT and drive the Optics with the OPTICS CONTROL STICK until the shaft and trunnion angles as indicated on the SCT TPAC's are approximately zero, then repeat step 6.2.11.5.

NOTE: If Optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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- 6.2.12.5.2 Note that the autocollimator reticle contains a series of lines of different thickness and width. Each set of lines is marked with a number (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines. The SXT resolution shall be at least 10 arc-seconds at the center of the field of view.
- 6.2.12.5.3 Repeat 6.2.12.5.1 and 6.2.12.5.2 using the SCT and the SCT resolution chart. The SCT shall have a resolution of at least 3 arc-minutes at the center of the field of view.
- 6.2.12.6 Slave Telescope Mode Checks
- 6.2.12.6.1 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.6.2 Set the OPTICS MODE switch on the Control Indicator Panel to ZERO. After 20 seconds return the OPTICS MODE switch to MAN.
- 6.2.12.6.3 Record the SCT Shaft and Trunnion angles as indicated by the TPAC and the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between the TPAC Shaft angle and the Shaft CDU angle shall be $\pm 0.11^\circ$ or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be $\pm 0.22^\circ$ or less.
- 6.2.12.6.4 Using the OPTICS CONTROL STICK and CONTROLLER SPEED switch, drive the SXT Shaft and Trunnion CDU's until R1 = $+035.00 \pm 0.10$ deg. and R2 = $+35.000 \pm 0.100$ deg. Record R1 and R2. Record the Shaft and Trunnion angles as indicated by the TPAC. The difference between the TPAC Shaft angle and Shaft CDU angle shall be $\pm 0.11^\circ$ or less. The difference between the TPAC Trunnion angle and Trunnion CDU angle shall be $\pm 0.22^\circ$ or less.
- 6.2.12.6.5 Set the OPTICS MODE switch to ZERO. After 20 seconds return the OPTICS MODE switch to MAN.
- 6.2.12.6.6 Set the TELESCOPE TRUNNION switch to the 0° position.

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- 6.2.12.6.7 Remove the plug from the base of the SXT eyepiece and install the Adapter Assembly and Portable Light Assembly. Turn on the light.
NOTE: If needed to reduce external light, place a photographers hood over the optics head and retroreflecting prism.
- 6.2.12.6.8 By sighting through the SCT eyepiece, position the Retroreflecting Prism, Model No. A23-200, to span between the SXT SLOS and SCT LOS such that the illumination from the backlight filament is clearly visible at the center of the field of view.
- 6.2.12.6.9 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Using the OPTICS CONTROL STICK, adjust the trunnion CDU to bring the SCT horizontal reticle line into coincidence with the SXT horizontal reticle line. Record the Trunnion CDU angle displayed in R2 as XX.XXX degrees. The difference between this angle and the corresponding angle recorded in 6.2.12.6.3 shall be $\pm 0.2^\circ$ or less.
- 6.2.12.6.10 Replace the Portable Light in the adapter on the SXT eyepiece.
- 6.2.12.6.11 Set the OPTICS MODE switch to ZERO. After 20 seconds return the OPTICS MODE switch to MAN. Set the TELESCOPE TRUNNION switch to SLAVE TO SXT.
- 6.2.12.6.12 Temporarily disable the SCT TRUNNION electrical drive by carefully unscrewing the SCT TRUNNION Manual Drive until it just releases from the panel. Do not rotate further, as this would displace the SCT LOS from the desired reference position.
- 6.2.12.6.13 Remove the Portable Light from the adapter and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in step 6.2.12.6.9. Again using the OPTICS CONTROL STICK, bring the SCT horizontal reticle line into coincidence with the SXT horizontal reticle. Record the Trunnion CDU angle displayed in R2. The difference between this angle and the corresponding angle measured in 6.2.12.6.3 shall be $\pm 0.2^\circ$ or less. Replace the Portable Light Assembly in the adapter.
- 6.2.12.6.14 Replace the SCT TRUNNION Manual Drive in the panel.
- 6.2.12.6.15 Use the OPTICS CONTROL STICK to drive the Trunnion CDU to $+25.000^\circ \pm 0.006^\circ$ as indicated on R2. Maintain the Shaft CDU at $000.00^\circ \pm 0.01^\circ$ as indicated on R1.
- 6.2.12.6.16 Set the TELESCOPE TRUNNION switch to 25°. After 30 seconds has elapsed, record the TPAC Trunnion angle and Trunnion CDU angle displayed in R2. The difference shall be $\pm 0.22^\circ$ or less. Record the Shaft CDU angle displayed in R1.
- 6.2.12.6.17 Temporarily disable the electrical drive to the SCT Trunnion and SCT Shaft by unscrewing the SCT Trunnion and Shaft Manual Drive items until they just release from the panel. Do not rotate further, as this would displace the SCT LOS from the desired reference position.

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6.2.13 Optics Slew Rate Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On procedure, before proceeding.

6.2.13.1 Set/Verify the G/N POWER-OPTICS switch on the LFB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $+28.0 \pm 3.0$ VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.

6.2.13.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.

- VERB 41 NOUN 20, ENTER
- +00000, ENTER
- +00000, ENTER
- +00000, ENTER

6.2.13.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the positions indicated.

- TELESCOPE TRUNNION to SLAVE to EXT
- CONTROLLER COUPLING to DIRECT
- CONTROLLER SPEED to HI

6.2.13.4 Monitor the OCDU's by entering VERB 16 NOUN 55 into K148. Press the ENTER pushbutton.

6.2.13.5 Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following data displayed in R1 and R2 on the DSKY.

- $R1 = +000.00 \pm 000.03$ (Shaft Angle)
- $R2 = +00.000 \pm 00.006$ (Trunnion LOS Angle)

Set the OPTICS MODE switch on the G&N Indicator Panel to MAN.

NOTE: Read & understand step 6.2.13.6 before proceeding. Do not hold Control Stick at upper limit more than 10 seconds, or exceed a trunnion angle of 85°
 Trunnion Slew Rate - HI Speed

6.2.13.6 Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 5 seconds after the first mark, again press the MARK pushbutton and record the new display in R2 and R3. The data displayed is in the following form:

- $R2 = \pm XX.XXX$ (Trunnion LOS angle in deg.)
- $R3 = +XXX.XX$ (Time in seconds)

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6.2.13.7 Perform the following calculations:

- a. Difference between R2 displays = $\frac{\Delta \text{ trun. angle}}{\Delta \text{ time}}$
 b. Difference between R3 displays = $\frac{\Delta \text{ time}}{\Delta \text{ trun. angle}}$
 c.

$$\frac{\Delta \text{ trun. angle}}{\Delta \text{ time}} = \text{deg/sec}$$

T

The Trunnion slew rate shall be 10±2 deg/sec.

Shaft Slew Rate - HI Speed

- 6.2.13.8 Using the Optics Control Stick, drive the Trunnion LOS Angle back to approximately zero degrees as indicated on the TPAC. Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read and understand step 6.2.13.9 before proceeding. Do not hold Control Stick at right limit for more than 10 seconds, or exceed a shaft angle of 250°.

- 6.2.13.9 Push and hold the Optics Control stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 5 seconds after the first mark, again press the MARK pushbutton and record the new display in R1 and R3. The data displayed is in the following form.

R1 = + XXX.XX (Shaft angle in deg.)
 R3 = + XXX.XX (Time in seconds)

6.2.13.10 Perform the following calculations

- a. Difference between R1 displays = $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}}$
 b. Difference between R3 displays = $\frac{\Delta \text{ time}}{\Delta \text{ shaft angle}}$
 c.

$$\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \text{deg/sec}$$

The Shaft Slew Rate shall be 18.5±3.9 deg/sec.

Trunnion Slew Rate - MED Speed

- 6.2.13.11 Using the Optics Control Stick, drive the shaft angle back to approximately zero degrees as indicated on the TPAC. Set the OPTICS MODE switch to zero. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to MED.

NOTE: Read & understand 6.2.13.12 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

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6.2.13.12 Push and hold the Optics Control stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 10 seconds after the first mark, again press the MARK pushbutton and record the new display in R2 & R3. The data displayed is in the following form:

- a. R2 = XX.XXX (Trunnion LOS Angle in degrees)
- b. R3 = XXX.XX (Time in seconds)

6.2.13.13 Perform the following calculations:

- a. Difference between R2 displays = ____ (Δ Trunnion Angle)
- b. Difference between R3 displays = ____ (Δ Time)

$$\frac{\Delta \text{Trunnion angle}}{\Delta \text{Time}} = \text{____ deg./sec}$$

The Trunnion slew rate shall be 1.0±0.2/sec.

Shaft Slew Rate - MED Speed

6.2.13.14 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read & understand 6.2.13.15 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.15 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 10 seconds after the first mark, again press the MARK pushbutton and record the new display in R1 and R3. The data displayed is in the following form:

- a. R1 = ± XXX.XX (Shaft Angle in degrees)
- b. R3 = ± XXX.XX (Time in seconds)

6.2.13.16 Perform the following calculations

- a. Difference between R1 displays = ____ (Δ Shaft Angle)
- b. Difference between R3 displays = ____ (Δ Time)

$$\frac{\Delta \text{Shaft Angle}}{\Delta \text{Time}} = \text{____ deg/sec}$$

Δ Time

The Shaft Slew Rate shall be 2.0±0.4 deg/sec.

Trunnion Slew Rate - LO Speed

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6.2.14 Stabilization Loop Step Response Test

6.2.14.1 Proceed with this test if the Operate Power On Test of 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding. Insure that the Carry-on Command Stimuli Unit, Model No. C14-200, is installed and connected.

6.2.14.2 Enter VERB 36 into K148. Press the ENTER pushbutton, then the ERROR RESET pushbutton.

6.2.14.3 Inner Gimbal Response Test

6.2.14.4.1 Enter code 2032000000 in C-START Module 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2117 IGA SERVO ERROR on 4A1-A3-CH1.

6.2.14.4.2 Enter VERB 41 NOUN 20 into K148. Press ENTER pushbutton.

6.2.14.4.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.

6.2.14.4.4 Enter VERB 42 into K148. Press ENTER.

6.2.14.4.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.

6.2.14.4.6 Enter 1000 into 4A2-A6-R155. The top part of the switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.

6.2.14.4.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the IG stabilization loop.

CAUTION: If the transient caused by the step input does not die out within 15 seconds, remove the DMU OPERATE power by setting the G/M POWER DMU switch on the LEB Lighting Control Panel to OFF.

6.2.14.4.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.

6.2.14.4.9 Enter 0000 into 4A2-A6-R155; the top part of switch should be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the IG Stabilization Loop. The bottom part of switch shall be extinguished.

6.2.14.4.10 After the transient has died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step input and the settling of the error signal to a value equal to 25 percent of the original step amplitude. In addition, record the total number of overshoots.

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- 6.2.14.4.10.1 The inner gimbal stabilization loop response time shall be less than 0.1 second.
- 6.2.14.4.10.2 The maximum number of overshoots on the IGA Servo Error signals shall be three.
- 6.2.14.5 Middle Gimbal Response Test
- 6.2.14.5.1 Enter code 2028000000 into C-START MODULE 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2147 MGA SERVO ERROR on 4A1-A3-CH1.
- 6.2.14.5.2 Enter VERB 41 NOUN 20 into K148. Press ENTER.
- 6.2.14.5.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.
- 6.2.14.5.4 Enter VERB 42 into K148. Press ENTER.
- 6.2.14.5.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.
- 6.2.14.5.6 Enter 0100 into 4A2-A6-R155. The top part of switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.
- 6.2.14.5.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the MG Stabilization Loop.
- CAUTION: If the transient caused by the step input does not die within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.
- 6.2.14.5.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.
- 6.2.14.5.9 Enter 0000 into 4A2-A6-R155. The top part of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press XEQ/SEAL pushbutton to remove the step input to the MG stabilization loop.
- 6.2.14.5.10 After the transients have died out, stop the analog recorder. Record the stab loop response time by measuring the time interval between removing the step input and the settling of the error signals to a value equal to ± 5 percent of the original step amplitude. In addition, record the total number of overshoots.
- 6.2.14.5.10.1 The middle gimbal stabilization loop response time shall be less than 0.1 second.
- 6.2.14.5.10.2 The maximum number of overshoots on the MGA Servo Error signals shall be three.

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6.2.14.6 Outer Gimbal Response Test

6.2.14.6.1 Enter code 2026000000 in C-START Module 4A1-A5-C156. Press XEQ/SEAL pushbutton to call up CG 2177 OGA SERVO ERROR on 4A1-A3-CHL.

6.2.14.6.2 Enter VERB 41 NOUN 20 into K148. Press ENTER.

6.2.14.6.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.

6.2.14.6.4 Enter VERB 42 into K148. Press ENTER pushbutton.

6.2.14.6.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.

6.2.14.6.6 Enter 0010 into 4A2-A6-R155. The top half of the switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.

6.2.14.6.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the CG Stabilization Loops.

NOTE: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/M POWER IMU switch on the LEB Lighting Control Panel to OFF.

6.2.14.6.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.

6.2.14.6.9 Enter 0000 into 4A2-A6-R155. The top half of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the CG Stabilization Loop.

6.2.14.6.10 After the transients have died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step input and the settling of the error signal to a value equal to 25 percent of the original step amplitude. In addition, record the total number of overshoots.

6.2.14.6.10.1 The outer gimbal stabilization loop response time shall be less than 0.7 second.

6.2.14.6.10.2 The maximum number of overshoots on the OGA Servo Error Signals shall be three.

6.2.14.7 Enter VERB 40 NOUN 20 into K148. Press the ENTER pushbutton.

6.2.14.7.1 Enter VERB 41 NOUN 20 into K148. Press the ENTER pushbutton.

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- 6.2.14.7.2 Enter +00000 into K148. Press the ENTER pushbutton.
- 6.2.14.7.3 Enter +00000 into K148. Press the ENTER pushbutton.
- 6.2.14.7.4 Enter +00000 into K148. Press the ENTER pushbutton.

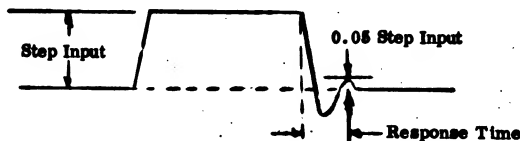


Figure 1. Typical Step Input Response

Source: Apollo Guidance System Information

- 6.2.15 IRIG Scale Factor Test
- 6.2.15.1 Proceed with this test if the Operate Power On Test of 6.2.3 or the Turn On Procedure of 6.2.5.2 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 before proceeding.
- 6.2.15.2 Verify that the IMU OPERATE power has been applied for a minimum of 1 hour, and that at least 1 hour has elapsed since running of the Gimbal Friction Test, 6.2.7.
- 6.2.15.3 Set up the Analog Recorders to monitor the following signals:
- a. CG 2117 IG SERVO ERROR
 - b. CG 2147 MG SERVO ERROR
 - c. CG 2177 OG SERVO ERROR
 - d. CG 2120 IG TM CURRENT
 - e. CG 2150 MG TM CURRENT
 - f. CG 2180 OG TM CURRENT
- 6.2.15.3.1 Start the analog recorder chart drive using a chart speed of 1 mm/sec. The recorder shall run for the duration of 6.2.15.
- 6.2.15.4 Enter VERB 57 into K148. Press the ENTER pushbutton.
- 6.2.15.5 Enter 00005 into K148. Press the ENTER pushbutton.
- 6.2.15.6 VERB 06 NOUN 61 shall flash on CRT and the following displayed in R1 and R2:
- R1 = xxxxxx (some Nav. Base azimuth)
- R2 = xxxxxx (some test site latitude; see Table I)

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6.2.15.10 After 160 seconds VERB 06 NOUN 66 shall flash on the CRT. Record the value displayed in register R1 for the appropriate Test Number in Table 2. The data displayed in the Scale Factor error in parts per million. The recorded Scale Factor error shall not exceed ± 1750 ppm.

Table 2. Display of Test Parameters

<u>Test Number</u>	<u>Symbol</u>	<u>Display in R1</u>
-00001	E+X	XXXXX
+00001	E-X	XXXXX
-00002	E+Y	XXXXX
+00002	E-Y	XXXXX
-00003	E+Z	XXXXX
+00003	E-Z	XXXXX

- 6.2.15.11 Enter VERB 33 into K148. Press the ENTER pushbutton.
- 6.2.15.12 Repeat 6.2.15.9 through 6.2.15.10 until all Test Numbers in Table 1 have been utilized.
- 6.2.15.13 Enter VERB 34 into K148. Press the ENTER pushbutton.
- 6.2.15.13.1 After completion of all test numbers, stop the analog recorders.
- 6.2.15.14 Enter VERB 40 NOUN 20 in K148. Press the ENTER pushbutton.
- 6.2.15.14.1 Enter VERB 41 NOUN 20 into K148. Press the ENTER pushbutton.
- 6.2.15.14.2 Enter +00000 into K148 three times, pressing the ENTER pushbutton after each entry.
- 6.2.16 IMU Performance Test
- 6.2.16.1 Proceed with this test if the Operate Power On Test of 6.2.3 or the Turn On Procedure of 6.2.5.2 has been completed and system operation has not been interrupted. If the system operation has been interrupted, perform Turn On Procedure of 6.2.5.2 before proceeding with this test.
- 6.2.16.2 Enter VERB 01 NOUN 10 into K148. Press the ENTER pushbutton. Enter 00003 into K148. Press the ENTER pushbutton. Record R1 = AAAAA and the time of day.
- 6.2.16.3 Enter VERB 21 NOUN 02 into K148. Press the ENTER pushbutton. Enter 01300 into K148. Press ENTER. Enter AAAAA into K148. Press ENTER.
- 6.2.16.4 Enter VERB 06 NOUN 02 into K148. Press ENTER. Enter 01300 into K148. Press ENTER. Record R1 = BBBB.

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6.2.16.5 Perform the following calculations:

- $R1 (BBBB) \times 5.12 = CCCC.C$ (hrs. in high order scaler channel 3)
3600
- $23.3 - CCC.C = DDDDD$ Hrs.
- Add DDDDD to time of day recorded in step 1.

Do Not enter any of the PIPA scale factor tests within -0.2 hours of the time of day calculated in step 6.2.16.5c. This is the time at which the high order scaler, channel 3, will overflow. If a PIPA scale factor test is being performed at this time, unacceptable test results will occur.

6.2.16.6 Verify that the DMU Operate Power has been applied for at least one hour.

6.2.16.7 Test Initiation.

6.2.16.7.1 Enter the following into K148.

- VERB 01 NOUN 01, ENTER
 - 00362, ENTER
- Record R1 = XXXXY

6.2.16.7.2 Enter the following into K148

- VERB 21 NOUN 01, ENTER
- 00362, ENTER
- XXXXY', ENTER where Y' is determined by Table XV and XXXX is that recorded in 6.2.16.7.1.

TABLE XV

Y (from 6.2.16.7.1)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.16.7.3 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.16.7.4 Enter 00001 into K148. Press the ENTER pushbutton.

6.2.16.7.5 VERB 06 NOUN 61 shall appear flashing on CRT and will contain the following information:

R1 = xxx.xx (Some NB Azimuth)
R2 = xx.xxx (Some Test Site Latitude)

Insure that R1 = Correct NB Azimuth and R2 = Present Test Site Latitude from Table XX.

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6.2.16.7.6 If R1 does not contain the correct NB Azimuth, enter the following sequence into K148.

- a. VERB 21, ENTER
- b. +xxx,xx, ENTER (where +xxxxx is the NB Azimuth)

6.2.16.7.7 If R2 does not contain present Test Site Latitude enter the following sequence into K148:

- a. VERB 22, ENTER
- b. Proper Data from Table XX, ENTER

Table XX

<u>Location</u>	<u>Latitude</u>
NAA	+33.921
MSC	+28.556
MILA	+28.516

6.2.16.7.8 Enter VERB 33 into K148. Press ENTER pushbutton.

6.2.16.7.9 VERB 06 NOUN 66 shall appear flashing on CRT. Verify that the following values appear on CRT.

R1 = +00900
R2 = +00000
R3 = +00001

6.2.16.7.10 If the contents of R1 on the CRT are not +00900, enter the following sequence into K148.

- a. VERB 21, ENTER
- b. +00900, ENTER

6.2.16.7.11 If the contents of R3 on the CRT are not +00000, enter the following sequence into K148:

- a. VERB 22, ENTER
- b. +00000, ENTER

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- 6.2.16.7.12 If the contents of R3 on the CRT are not +00001, enter the following sequence into K148:
- a. VERB 23, ENTER
 - b. +00001, ENTER
- 6.2.16.7.13 Verify correct display in R1, R2, and R3. Enter VERB 33 into K148. Press the ENTER pushbutton.
- 6.2.16.7.14 After approximately 17 minutes, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the value of CRT for R2 on the calculation sheet.
- 6.2.16.7.15 Enter VERB 33 into K148. Press the ENTER pushbutton.
- 6.2.16.7.16 After approximately 90 sec, VERB 06, NOUN 66 shall appear flashing on the CRT. Record the value on CRT for R1 and R2 on the calculation sheet.
- 6.2.16.7.17 Enter VERB 34 into K148. Press the ENTER pushbutton.
- 6.2.16.7.18 Repeat steps 6.2.16.3.7 through 6.2.16.3.14, substituting position number +00002 in R3.
- 6.2.16.7.19 Enter VERB 33 into K148. Press ENTER pushbutton.
- 6.2.16.7.20 After approximately 67 minutes, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the value on CRT for R2 on the calculation sheet.
- 6.2.16.7.21 Repeat steps 6.2.16.3.6 through 6.2.16.3.14, substituting position number +00003 in R3.
- 6.2.16.7.22 Repeat steps 6.2.16.3.15 through 6.2.16.3.18, substituting position number +00004 in R3.
- 6.2.16.7.23 Enter VERB 33 into K148. Press ENTER pushbutton.

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- 6.2.16.7.24 VERB 06 NOUN 66 shall flash on the CRT. Verify the following data is also displayed on the CRT.
- a. R1 = +00900
 - b. R2 = +00000
 - c. R3 = +00005
- If data is incorrect perform steps 6.2.16.3.8 thru 6.2.16.3.10 entering the correct data. Enter VERB 33 into K148. Press ENTER pushbutton.
- The PROGRAM ALARM and GIMBAL LOCK status lights shall be illuminated on the DSKY.
- 6.2.16.7.25 Press the RESET pushbutton. The Program Alarm lamp shall extinguish. In approximately 90 sec, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the data displayed in R1 and R2 on the CRT.
- 6.2.16.7.26 Enter VERB 34 into K148. Press ENTER pushbutton. Repeat steps 6.2.16.3.22 thru 6.2.16.3.23 substituting position no. +00006.
- 6.2.16.7.27 Enter VERB 34 into K148. Press the ENTER pushbutton. VERB 06 NOUN 66 shall flash on the CRT. Verify the following data is also displayed on the CRT.
- a. R1 = +00900
 - b. R2 = +00000
 - c. R3 = +00007
- If the data is incorrect perform steps 6.2.16.3.8 thru 6.2.16.3.10 entering the correct data.
- 6.2.16.7.28 Enter VERB 33 into K148. Press ENTER pushbutton. The GIMBAL LOCK status lamp shall extinguish. In approximately 17 minutes VERB 06 NOUN 66 shall flash on the CRT. Record the data displayed in R2 of the CRT.
- 6.2.16.7.29 Repeat steps 6.2.16.3.25 and 6.2.16.3.26 substituting position no. +00008 in R3.
- 6.2.16.7.30 Repeat steps 6.2.16.3.25 and 6.2.16.3.26 substituting position no. +00009 in R3.
- 6.2.16.7.31 Repeat steps 6.2.16.3.25 and 6.2.16.3.26 substituting position no. +00010 in R3.
- 6.2.16.8 To terminate the IMU Performance Test, enter VERB 36 into K148. Press ENTER pushbutton.
- 6.2.16.9 Enter the following sequence in K148.
- a. VERB 40 NOUN 20, ENTER
 - b. VERB 41 NOUN 20, ENTER
 - c. +00000, ENTER
 - d. +00000, ENTER
 - e. +00000, ENTER

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6.2.16.10 Calculations

Table XXI

Position No. As Displayed in R3	Quantity Being Measured
+00001	+NBDY +X PIPA G
+00002	+NBDZ -X PIPA G -NBDX + ADIAX
+00003	-NBDX +Z PIPA G
+00004	+NBDY + ADSRAY -Z PIPA G +NBDZ + ADIAZ
+00005	+ Y PIPA G
+00006	- Y PIPA G
+00007	-NBDX + .707 ADSRAX
+00008	.707 (-NBDZ - NBDY) + .5 (ADIAZ - ADIAX) +.5 (ADSRAY + ADSRAZ)
+00009	-NBDZ + .707 ADSRAZ
+00010	.707 (NBDY - NBDX) + .5 (ADIAX - ADIAX) +.5 (ADSRAX)

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6.2.16.10.1

Measured Values

	Line	Position No.	Step No.	Parameter	Recorded Value
6.2.16.10.1.1	1	+00001	6.2.16.7.12	+NBDY	R2
6.2.16.10.1.2	2	+00001	6.2.16.7.14	+XPIPAG	R1 . R2
6.2.16.10.1.3	3	+00002	6.2.16.7.12	+NBDZ	R2
6.2.16.10.1.4	4	+00002	6.2.16.7.14	-XPIPAG	R1 . R2
6.2.16.10.1.5	5	+00002	6.2.16.7.18	-NBDX + ADIAZ	R2
6.2.16.10.1.6	6	+00003	6.2.16.7.12	-NBDX	R2
6.2.16.10.1.7	7	+00003	6.2.16.7.14	+ZPIPAG	R1 . R2
6.2.16.10.1.8	8	+00004	6.2.16.7.12	+NBDY + ADSRAY	R2
6.2.16.10.1.9	9	+00004	6.2.16.7.14	-ZPIPAG	R1 . R2
6.2.16.10.1.10	10	+00004	6.2.16.7.18	+NBDZ + ADIAZ	R2
6.2.16.10.1.11	11	+00005	6.2.16.7.23	+YPIPAG	R1 . R2
6.2.16.10.1.12	12	+00006	6.2.16.7.23	-YPIPAG	R1 . R2
6.2.16.10.1.13	13	+00007	6.2.16.7.26	-NBDX + .707ADSRAX	R2
6.2.16.10.1.14	14	+00008	6.2.16.7.26	.707 (-NBDZ - NBDY) + .5 (ADIAZ-ADIAZ) +.5 (ADSRAY + ADSRAZ)	R2
6.2.16.10.1.15	15	+00009	6.2.16.7.26	-NBDZ + .707ADSRAX	R2
6.2.16.10.1.16	16	+00010	6.2.16.7.26	.707(NBDY - NBDX) + .5 (ADIAZ - ADIAZ) + .5 ADSRAX	R2

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6.2.16.10.2 Compute the average G for each PIPA using the recorded values in 6.2.16.6.1

a. For XPIPA, $G_x = \frac{\text{line 2} - \text{line 4}}{2} =$

b. For YPIPA, $G_y = \frac{\text{line 11} - \text{line 12}}{2} =$

c. For ZPIPA, $G_z = \frac{\text{line 7} - \text{line 9}}{2} =$

6.2.16.10.3 Compute the PIPA scale factor from the values obtained in 6.2.16.6.2 and the value of local gravity obtained from Table XLII as follows:

a. $h_x = \frac{5.85(\text{local } g)}{G_x} =$

b. $h_y = \frac{5.85(\text{local } g)}{G_y} =$

c. $h_z = \frac{5.85(\text{local } g)}{G_z} =$

6.2.16.20.3.1 The PIPA scale factor shall be 5.85000 ± 0.00234 cm/sec/pulse.

Table XLII. Local Gravity Requirements

Location	Local Gravity (cm/sec ²)
NAA	979.56
MSC	979.29
MILA	979.24

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¹⁰
6.2.16.10.4 Compute the PIPA bias values using the values obtained in 6.2.16.6.2 as follows:

a. $b_x = \frac{\text{line 2} + \text{line 4}}{2} =$

b. $b_y = \frac{\text{line 11} + \text{line 12}}{2} =$

c. $b_z = \frac{\text{line 7} + \text{line 9}}{2} =$

¹⁰
6.2.16.10.4.1 The PIPA bias values shall not exceed 0.50 cm/sec^2 .

6.2.16.10.5 Calculate NBD, ADSRA. ADIA using the values obtained in 6.2.16.6.2.

a. $\text{NBDX} = -(\text{line 6}) =$
 $\text{NBDY} = \text{line 1} =$
 $\text{NBDZ} = +(\text{line 3}) =$

b. $\text{ADSRAX} = \frac{(\text{line 13} - \text{line 6})}{.707}$
 $\text{ADSRAY} = \text{line 8} - \text{line 1}$
 $\text{ADSRAZ} = \frac{+\text{line 15} + \text{line 3}}{.707}$

c. $\text{ADIAX} = \text{line 5} - \text{line 6}$
 $\text{ADIAY} = \frac{\text{line 16} - .707(\text{NBDY} - \text{NBDX}) - .5 (\text{ADSRAX} - \text{ADIAX})}{.5}$

$\text{ADIAZ} = \text{line 10} - \text{line 3}$

6.2.16.10.5.1 Obtain the following values from the latest performance of JDC 12217 at AC Electronics.

a. $\text{NBDX} = \underline{\hspace{2cm}} \text{ meru}$
 $\text{NBDY} = \underline{\hspace{2cm}} \text{ meru}$
 $\text{NBDZ} = \underline{\hspace{2cm}} \text{ meru}$

b. $\text{ADSRAX} = \underline{\hspace{2cm}} \text{ meru}$
 $\text{ADSRAY} = \underline{\hspace{2cm}} \text{ meru}$
 $\text{ADSRAZ} = \underline{\hspace{2cm}} \text{ meru}$

c. $\text{ADIAX} = \underline{\hspace{2cm}} \text{ meru}$
 $\text{ADIAY} = \underline{\hspace{2cm}} \text{ meru}$
 $\text{ADIAZ} = \underline{\hspace{2cm}} \text{ meru}$

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6.2.16.7.6

Calculate Δ NBD, Δ ADSRA, and Δ ADIA by taking the differences between the respective NBD, ADSRA, and ADIA terms in 6.2.16.5 and 6.2.16.5.1.

- a. Δ NBDX = _____ meru
 Δ NBDY = _____ meru
 Δ NBDZ = _____ meru
- b. Δ ADSRAX = _____ meru
 Δ ADSRAY = _____ meru
 Δ ADSRAZ = _____ meru
- c. Δ ADIAX = _____ meru
 Δ ADIAY = _____ meru
 Δ ADIAZ = _____ meru

Δ NBD shall not exceed ± 5 meru.

Δ ADSRA shall not exceed ± 10 meru.

Δ ADIA shall not exceed ± 15 meru.

6.2.16.7.6.1

Evaluate results to determine IMU Performance Test passed or failed.

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6.2.17 SXT-NB-IMU Fine Alignment Test

6.2.17.1 Proceed with this test if the Operate Power On Test 6.2.3 has been completed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2.

6.2.17.2 Prior to performing this test, the G&N Installation Qualification fixture shall be installed on the supporting fixture and adjusted to permit proper operation of the G&N optics. The azimuth supplied by the azimuth autosect (Optical Reference No. 1) shall be known to ± 30 minutes of arc.

NOTE: The G&N shall have had OPERATE power applied for a minimum of 1 hour. Set the G/N POWER-OPTICS switch to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0 \pm 3.0 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.

6.2.17.3 Enter VERB 01 NOUN 10 into K148. Press the ENTER pushbutton. Enter 00003 into K148. Press the ENTER pushbutton. Record AAAAA and the time of day.

6.2.17.4 Enter VERB 21 NOUN 02 into K148. Press the ENTER pushbutton. Enter 01300 into K148. Press the ENTER pushbutton. Enter AAAAA into K148. Press the ENTER pushbutton.

6.2.17.5 Enter VERB 06, NOUN 02 into K148. Press ENTER. Enter 01300 into K148. Press ENTER. Record R1 = BBBB.

6.2.17.6 Perform the following calculations:

a. $\frac{R1 (BBBB) \times 5.12}{3600}$ - CCCC.C (Hrs. in high order scaler channel 3)

b. 23.3 - CCCC.C = DDDDD Hrs.

c. Add DDDDD to time of day recorded in step 1.

DO NOT enter any of the PIPA misalignment tests within -0.2 hours of the time of day calculated in step 6.2.17.6c. This is the time at which the high order scaler, channel 3, will overflow. If a PIPA misalignment test is being performed at this time, unacceptable test results will occur.

6.2.17.7 Enter the following sequence into the Lower Equipment Bay (LEB) DSKY.

a. VERB 41 NOUN 20 ENTER

b. +00000, ENTER

c. +00000, ENTER

d. +00000, ENTER

6.2.17.8 On the G&N Indicator Control Panel set the following switches to the position indicated.

a. TELESCOPE TRUNNION to SLAVE to SXT

b. CONTROLLER COUPLING to DIRECT

c. CONTROLLER SPEED to LO

d. OPTICS MODE to MAN.

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6.2.17.9 Enter the following into the DSKY.

- a. VERB 01 NOUN 01, ENTER
- b. 00362, ENTER
- Record R1 = XXXXY

6.2.17.10 Enter the following into the DSKY

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table II and XXXX is that recorded in 6.2.17.9.

TABLE II

Y (From 6.2.17.9)	0	1	2	3	4	5	6	7
Y'	2	3	2	2	6	7	6	7

6.2.17.11 Initiate the test by entering the following sequence into the LEB DSKY.

- a. VERB 57, ENTER
- b. 00003, ENTER

6.2.17.12 Observe VERB 06 NOUN 66 flashing on the DSKY. The following data is displayed in R1 and R2 on the DSKY.

- a. R1 = +13500
- b. R2 = +xx.xxx (Site Latitude from Table I)

TABLE I

Test Site	Latitude
NAA	+33.922
MILA	+28.516
MSC	+29.556

6.2.17.13 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If the value displayed is other than +13500 in R1 and the correct Site Latitude in R2, correct the data by entering the following sequence into the DSKY.

- a. VERB 21, ENTER
- b. +13500, ENTER
- c. VERB 22, ENTER
- d. +xx.xxx, ENTER (+xx.xxx = Site Latitude from Table I)
- e. VERB 33, ENTER

6.2.17.14 Observe VERB 21 NOUN 30 flashing on the DSKY. Enter the following sequence into the DSKY.

- a. +00001, ENTER (Position Number)
- b. +00000, ENTER
- c. +00001, ENTER

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6.2.17.15 Observe VERB 06 NOUN 66 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.

- a. R1 = +xxx.xx (Y_{NB} Azimuth)
- b. R2 = ±xx.xxx (Y_{NB} Elevation)
- c. R3 = 00001

6.2.17.16 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct Y_{NB} azimuth and elevation, correct the data by entering the following sequence into the DSKY.

- a. VERB 24, ENTER
- b. +xxx.xx ± 002.00 degrees, ENTER (Y_{NB} azimuth)
- c. ±xx.xxx ± 02.000 degrees, ENTER (Y_{NB} elevation)
- d. VERB 33, ENTER

6.2.17.17 Observe VERB 06 NOUN 66 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.

- a. R1 = +xxx.xx (Z_{NB} Azimuth)
- b. R2 = ±xx.xxx (Z_{NB} Elevation)
- c. R3 = 00002

6.2.17.18 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct Z_{NB} azimuth and elevation, correct the data by entering the following sequence into the DSKY.

- a. VERB 24, ENTER
- b. +xxx.xx ± 002.00 degrees, ENTER (Z_{NB} Azimuth)
- c. ±xx.xxx ± 02.000 degrees, ENTER (Z_{NB} elevation)
- d. VERB 33, ENTER

6.2.17.19 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.

- a. R1 = +xxx.xx (Target 1 Azimuth)
- b. R2 = ±xx.xxx (Target 1 Elevation)
- c. R3 = 00001

6.2.17.20 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct azimuth and elevation for Target 1, correct the data by entering the following sequence into the DSKY.

- a. VERB 24, ENTER
- b. +xxx.xx ± 000.10 degrees, ENTER (Target 1 Azimuth)
- c. ±xx.xxx ± 00.010 degrees, ENTER (Target 1 Elevation)
- d. VERB 33, ENTER

6.2.17.21 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.

- a. R1 = +xxx.xx (Target 2 Azimuth)
- b. R2 = ±xx.xxx (target 2 Elevation)
- c. R3 = 00002

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- 6.2.17.22 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct azimuth and elevation for Target 2, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx±000.10 degrees, ENTER (Target 2 Azimuth)
 - ±xx.xxx±00.010 degrees, ENTER (Target 2 Elevation)
 - VERB 33, ENTER
- 6.2.17.23 Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds and return the OPTICS MODE switch to MAN. When VERB 51 NOUN 30 flashes on the DSKY set the OPTICS MODE switch on the G&N Indicator Control Panel to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.
- 6.2.17.24 Using the Optics Hand Controller, align the SXT S&LOS with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.25 When VERB 51 NOUN 30 flashes on the DSKY set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.
- 6.2.17.26 Using the Optics Hand Controller, align the SXT S&LOS with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.27 Repeat steps 6.2.17.23 through 6.2.17.26.
- 6.2.17.28 In approximately 7 minutes VERB 06 NOUN 66 shall flash on the DSKY and the test results shall be displayed. R1 and R2 on the DSKY shall display the misalignment of one of the horizontal PIPA's in arc seconds (R1 = whole, R2 = fractional). Record R1 and R2. (See Table II for PIPA displayed.)
- 6.2.17.29 Enter VERB 33 ENTER into the DSKY. When VERB 06 NOUN 66 flashes R1 and R2 on the DSKY shall display the misalignment of the second horizontal PIPA in arc seconds (R1 whole, R2 fractional). (See Table II for PIPA displayed.) Record R1 and R2.
- 6.2.17.30 Enter VERB 34 ENTER into the DSKY to terminate the test.
- 6.2.17.31 Repeat steps 6.2.17.11 through 6.2.17.27 substituting position No. 00002 in 6.2.17.14a.
- 6.2.17.32 Enter the following into the DSKY.
- VERB 36, ENTER
 - VERB 41 NOUN 20, ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER

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Table II. Display Conditions at Test Completion

Position	SM Orientation			6.2.17.28	6.2.17.29
	XSM	YSM	ZSM		
1	UP	SW	SE	Y PIPA about Z PIPA	Z PIPA about Y PIPA
2	SE	SW	DN	X PIPA about Y PIPA	Y PIPA about X PIPA
3*	SE	UP	SW	X PIPA about Z PIPA	Z PIPA about X PIPA

* Position 3 is not run in the Spacecraft because of GIMBAL LOCK considerations.

6.2.17.33 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.17.34 Calculations

- 6.2.17.34.1 a. YPIPA about Z misalignment = () R1 . R2
 b. ZPIPA about Y misalignment = () R1 . R2
 c. XPIPA about Y misalignment = () R1 . R2
 d. YPIPA about X misalignment = () R1 . R2

6.2.17.34.2 Enter the latest values from 6.2.16 IMU Performance Test.

- a. X PIPA bias = _____ cm/sec²
 b. Y PIPA bias = _____ cm/sec²
 c. Z PIPA bias = _____ cm/sec²
 d. $\theta_x = 210$ (X PIPA bias) = _____ arc sec.
 e. $\theta_y = 210$ (Y PIPA bias) = _____ arc sec.
 f. $\theta_z = 210$ (Z PIPA bias) = _____ arc sec.

- 6.2.17.34.3 a. Y PIPA about Z misalignment (Bias corrected) = 6.2.17.32.1a - θ_y = _____ arc sec.
 b. Z PIPA about Y misalignment (Bias corrected) = 6.2.17.32.1b - θ_z = _____ arc sec.
 c. X PIPA about Y misalignment (Bias corrected) = 6.2.17.32.1c - θ_x = _____ arc sec.
 d. Y PIPA about X misalignment (Bias corrected) = 6.2.17.32.1d - θ_y = _____ arc sec.

The PIPA misalignments, excluding PIPA bias, shall not exceed ± 150 arc seconds.

6.2.18 Gyrocompassing Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure.

- 6.2.18.1 Set the G/N POWER-OPTICS Switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0 \pm 3.0 VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90° h (CG 1212) are not flashing on the CRT.

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6.2.18.2 Enter the following into the DSKY.

- a. VERB 01 NOUN 01, ENTER
- b. 00362, ENTER
- Record R1 = XXXXY

6.2.18.3 Enter the following into the DSKY.

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table II and XXXX is that recorded in 6.2.18.2.

Table II

Y (From 6.2.18.2)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.18.4 Enter the following sequence into the K-Start, pressing ENTER pushbutton after each entry.

- a. VERB 57, ENTER
- b. 00006, ENTER

6.2.18.5 System shall advance to Gyrocompass System Test and display 01 on the CRT program display.

6.2.18.6 On the CRT observe VERB 06, NOUN 61 flashing with some launch azimuth displayed in R1 = +xxx.xx.

6.2.18.6.1 If the azimuth displayed is correct proceed to 6.2.18.5; if not, perform the following sequence:

- a. VERB 21, Press ENTER pushbutton
- b. +xxx.xx, press ENTER pushbutton (Correct Launch Azimuth)

6.2.18.7 After verifying that the correct launch azimuth is displayed in R1 on the CRT, Enter VERB 33 on the K-START and push the ENTER pushbutton.

6.2.18.8 Observe VERB 06 NOUN 61 flashing on the CRT with the following displayed in R1 and R2.

- a. R1 = +xxx.xx, Nav. Base Azimuth (Z_{NB})
- b. R2 = +xx.xxx, Site Latitude

6.2.18.8.1 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence:

To correct R1:

- a. VERB 21, ENTER
- b. +xxx.xx+000.50 degrees, ENTER (Z_{NB} Azimuth)

To correct R2:

- a. Verb 22, ENTER
- b. +xx.xxx, ENTER (Correct Site Latitude from Table I)

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- 6.2.18.9 After the correct data for R1 and R2 are verified enter VERB 33 into the K-Start. Press the ENTER pushbutton. On the CRT observe the PROGRAM display change to 05 after approximately 90 seconds. After approximately 15 minutes, observe the PROGRAM display change to 02.
- 6.2.18.10 After 120 minutes set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.11 Enter VERB 52 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT change to 03.
- 6.2.18.12 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 1 azimuth and elevation.
- R1 = +xxx.xx (Target 1 azimuth)
 - R2 = +00.000 (Target 1 elevation)
- 6.2.18.13 Verify the data appearing in R1 and R2 and if correct, proceed. If not correct, perform the following sequence.
- VERB 24, ENTER
 - +xxx.xx + 000.01, ENTER (Target 1 azimuth)
 - +00.000, ENTER (Target 1 elevation)
- 6.2.18.14 After the correct readings for R1 and R2 are verified, enter VERB 33 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.15 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 2 azimuth and elevation.
- R1 = +xxx.xx (Target 2 azimuth)
 - R2 = +00.000 (Target 2 elevation)
- 6.2.18.16 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence.
- VERB 24, ENTER
 - +xxx.xx + 000.01, ENTER (Target 2 azimuth)
 - +00.000, ENTER (Target 2 elevation)
- 6.2.18.17 After the correct readings for R1 and R2 are verified enter VERB 33 into the K-Start. Press the ENTER pushbutton.

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- 6.2.18.18 On the G&N Indicator Control Panel set the OPTICS MODE switch to MAN and the CONTROLLER SPEED to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target 1.
- 6.2.18.19 Set the CONTROLLER SPEED switch on the G&N Indicator Control Panel to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 1 and press the MARK pushbutton. If satisfied that the MARK was good, proceed. If not satisfied with MARK, press the MARK REJECT pushbutton and repeat the step.
- 6.2.18.20 Set the CONTROLLER SPEED switch to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target 2.
- 6.2.18.21 Set the CONTROLLER SPEED switch to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 2 and press the MARK pushbutton. If satisfied that the MARK was good, press the ENTER pushbutton. If not satisfied, press the MARK REJECT pushbutton and repeat this step.
- 6.2.18.22 On the CRT observe the following data displayed:
- VERB 06 NOUN 60
 - R1 = \pm xx.xxx (X gyre elevation error, degrees)
 - R2 = \pm xx.xxx (Y gyre elevation error, degrees)
 - R3 = \pm xx.xxx (Z gyre azimuth error, degrees)
- Record R1, R2 and R3.
- 6.2.18.23 Enter VERB 34 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT and DSKY's indicators. Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.24 Repeat steps 6.2.18.11 through 6.2.18.23 for the next hour at the following intervals.
- 15 minutes
 - 30 minutes
 - 45 minutes
 - 60 minutes

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6.2.18.25 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

6.2.18.26 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start three times. Press the ENTER pushbutton after each entry. Set the G/N POWER-OPTICS Switch on the LEB Lighting Control Panel to OFF.

6.2.18.27 Data Sheet

Line	Step No.	Parameter	Recorded Value
	6.2.18.22		
1		X Gyre Elevation Error	+ <u>R.1</u> degrees
2		Y Gyre Elevation Error	+ <u>R.2</u> degrees
3		Z Gyre Azimuth Error	+ <u>R.3</u> degrees
	6.2.18.24.a		
4		X Gyre Elevation Error	+ <u>R.1</u> degrees
5		Y Gyre Elevation Error	+ <u>R.2</u> degrees
6		Z Gyre Azimuth Error	+ <u>R.3</u> degrees
	6.2.18.24.b		
7		X Gyre Elevation Error	+ <u>R.1</u> degrees
8		Y Gyre Elevation Error	+ <u>R.2</u> degrees
9		Z Gyre Azimuth Error	+ <u>R.3</u> degrees
	6.2.18.24.c		
10		X Gyre Elevation Error	+ <u>R.1</u> degrees
11		Y Gyre Elevation Error	+ <u>R.2</u> degrees
12		Z Gyre Azimuth Error	+ <u>R.3</u> degrees
	6.2.18.24.d		
13		X Gyre Elevation Error	+ <u>R.1</u> degrees
14		Y Gyre Elevation Error	+ <u>R.2</u> degrees
15		Z Gyre Azimuth Error	+ <u>R.3</u> degrees

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6.2.18.28 Calculations Sheet

6.2.18.28.1 Record the most recent values of the following coefficients from 6.2.16, IMU Performance Test.

- a. NEDX = () _____
- b. NEDY = () _____
- c. NEDZ = () _____
- d. ADIAZ = () _____
- e. ADSRAY = () _____

6.2.18.28.2 Perform the following calculations. (Cos λ functions are provided in Table I.)

- a. $D(\text{vert}) = \text{NEDZ} - \text{ADIAZ}$
 $D(\text{vert}) = () \text{ meters}$
- b. $D(\text{east}) = \begin{matrix} \text{Sin (Launch Azimuth)} & \text{NEDX} + \\ \text{Cos (Launch Azimuth)} & \text{NEDY} + \text{ADSRAY} \end{matrix}$
- c. $\phi(\text{vert}) = \frac{D(\text{vert}) \times 24.2 + D(\text{east}) \times 206.26981}{3600 (\text{Cos } \lambda)}$
 $\phi(\text{vert}) = () \text{ degrees}$

Table I

Location	Latitude λ	Cos λ
NAA	33.917	0.82985
MILA	28.516	0.87868
MBC	29.556	0.86993

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6.2.18.38.3

Perform the following calculations using the recorded data from 6.2.18.27 and 6.2.18.28.2.

- a. Z Gyre azimuth error 2 hrs (corrected) = line 3 - ϕ (vert)
 Z Gyre azimuth error 2 hrs (corrected) = _____
 Corrected Z Gyre azimuth error (corrected) shall be 0.00 \pm 0.57 degrees
- b. X Gyre elevation error (2 hr) = line 1
 X Gyre elevation error (2 hr) = _____ degrees
- c. Y Gyre elevation error (2 hr) = line 2
 Y Gyre elevation error (2 hr) = _____ degrees
 The X and Y Gyre elevation errors shall be 0.00 \pm 0.08 degrees.
- d. Δ Z Gyre azimuth error (3 hr) = line 3 - line 15
 Δ Z Gyre azimuth error (3 hr) = _____ degrees
 Δ Z Gyre azimuth error shall be 0.00 \pm 0.06 degrees.
- e. Δ X Gyre elevation error (3 hr) = line 1 - line 13
 Δ X Gyre elevation error (3 hr) = _____ degrees
- f. Δ Y Gyre elevation error (3 hr) = line 2 - line 14
 Δ Y Gyre elevation error (3 hr) = _____ degrees
 Δ X and Δ Y Gyre elevation error shall be 0.00 \pm 0.03 degrees.

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6.2.19 CMC Voltage Margin Test

6.2.19.1 Verify that the G&N IMU HTR MNA and MNB breakers are engaged, computer MNA and MNB breakers are engaged, IMU MNA and MNB breakers are not engaged, and the G&N Power-IMU switch on the LEB Lighting-Control Panel is in the OFF position.

6.2.19.2 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to ON.

Caution: During the performance of this test the +4 VDC CMC Power Supply shall not be operated at less than +2.5 VDC or greater than 5.2 VDC (CG 1030). The +14 VDC CMC Power Supply shall not be operated at less than +8.5 VDC or greater than +17.0 VDC (CG 1020).

Note: The flashing indication of the CMC Power Supplies on CRT may be disregarded for this test. The charts in Table I may be used to determine approximate values for the "XX.X" values of C-156 voltage dial settings corresponding to various power supply voltages.

6.2.19.3 Units R-154 insert 0111. Verify and execute.

6.2.19.4 Insert in C-156 + XX.X001244 (Enter a value for XX.X which will adjust the +14 VDC Power Supply (CG1020) to 12.1 (+0.3, -0.0) VDC). Execute. Verify CG1020 on the CRT.

6.2.19.5 Insert in C-156 + XX.X001234 (Enter a value for XX.X which will adjust the +4 VDC Power Supply (CG1030) to 3.5 (+0.15, -0.0) VDC). Execute. Verify CG1030 on the CRT.

6.2.19.6 On K-148 press ERROR RESET

6.2.19.7 Initiate CMC Self-Check by inserting the following into K-148.

- a. VERB 21 NOUN 27, ENTER
- b. TTTTT, ENTER

Wait 200 seconds. Verify RESTART lamp on DSKY is not lighted.

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- 6.2.19.8 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on DSKY is lighted.
- 6.2.19.9 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to ON. Press ERROR RESET. Insert into K-148:
- a. VERB 21, NOUN 27, ENTER
 - b. TTTTT, ENTER
- 6.2.19.10 Insert into G-156 + XX.X001244 (Enter a value for XX.X which will adjust the +14 VDC CMC Power Supply (CG1020) to +16.4 (0.0, -0.4) VDC). Execute. Verify CG1020 on the CRT.
- 6.2.19.11 Press ERROR RESET on K-148. Wait 200 seconds. Verify RESTART lamp on DSKY is not lighted.
- 6.2.19.12 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to off. Verify RESTART lamp on the DSKY is lighted. Set the INHIBIT VOLTAGE FAIL switch to ON. Press ERROR RESET. Insert into K-148.
- a. VERB 21 NOUN 27, ENTER
 - b. TTTTT, ENTER
- 6.2.19.13 Insert into G-156 + XX.X001234 (Enter a value for XX.X which will adjust the +14 VDC CMC Power Supply (CG1030) to 4.6 (+0.0, -0.2) VDC). Execute. Verify CG1030 on the CRT.
- 6.2.19.14 Press ERROR RESET on K-148. Wait 200 seconds. Verify RESTART lamp on DSKY is not lighted
- 6.2.19.15 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on the DSKY is lighted. Set the INHIBIT VOLTAGE FAIL switch to on. Press ERROR RESET. Insert into K-148.
- a. VERB 21 NOUN 27, ENTER
 - b. TTTTT, ENTER
- 6.2.19.16 Insert into G-156 + XX.X001244 (Enter a value for XX.X which will adjust the +14 VDC CMC Power Supply (CG1020) to 12.1 (+0.3, -0.0) VDC). Execute. Verify CG1020 on the CRT.

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- 6.2.21 Spacecraft Control and Displays Test
- 6.2.21.1 Proceed with this test if the Operate Power On Test of 6.2.3 and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 before proceeding.
- 6.2.21.2 FDAI Attitude Error
- 6.2.21.2.1 Insert in K148
- a. V 57 ENTER
b. 00013 ENTER
- 6.2.21.2.2 Observe on CRT
- a. V 98 NO1 Flashing
b. PROG 07
c. NO ATT ON
d. R1, R2, and R3 Approx. 00000
- 6.2.21.2.3 Insert in K148
- a. VERB 33, ENTER
- 6.2.21.2.4 Observe on CRT
- a. V 98 NO1 Flashing
b. R1 +00385
c. R2 -00385
d. R3 +00385
e. NO ATT OFF
- 6.2.21.2.5 Record CRT indications
- a. CG 2279 ROLL ATT ERROR - CDU DAC OUT +16.88 ± 1.65 degrees
b. CG 2219 PITCH ATT ERROR - CDU DAC OUT -16.88 ± 1.65 degrees
c. CG 2249 YAW ATT ERROR - CDU DAC OUT +16.88 ± 1.65 degrees
- 6.2.21.2.6 Insert in K148
- a. VERB 33, ENTER
- 6.2.21.2.7 Observe on CRT
- a. V 98 NO1 Flashing
b. R1 +00384
c. R2 -00384
d. R3 +00384

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6.2.21.2.8 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	+16.88 ±1.65 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	+16.88 ±1.65 degrees

6.2.21.2.9 Insert in K148

a. VERB 33, ENTER

6.2.21.2.10 Observe on CRT

a. V 06	NO1	Flashing
b. R1		+00160
c. R2		-00160
d. R3		+00160

6.2.21.2.11 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	+6.95 ±0.69 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	-6.95 ±0.69 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	+6.95 ±0.69 degrees

6.2.21.2.12 Insert in K148

a. VERB 33, ENTER

6.2.21.2.13 Observe on CRT

a. V 06	NO1	Flashing
b. R1		+00135
c. R2		-00135
d. R3		+00135

6.2.21.2.14 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	+5.88 ±0.59 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	-5.88 ±0.59 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	+5.88 ±0.59 degrees

6.2.21.2.15 Insert in K148

a. VERB 33, ENTER

6.2.21.2.16 Observe on CRT

a. V 06	NO1	Flashing
b. R1		+00090
c. R2		-00090
d. R3		+00090

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6.2.21.2.17 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	+3.93 ±0.39 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	-3.93 ±0.39 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	+3.93 ±0.39 degrees

6.2.21.2.18 Insert in KI48

a. VERB 33, ENTER

6.2.21.2.19 Observe on CRT

a. V 06	NO1	Flashing
b. R1		+00000
c. R2		+00000
d. R3		-00090

6.2.21.2.20 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	0.00 ±0.19 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	0.00 ±0.19 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-3.93 ±0.39 degrees

6.2.21.2.21 Insert in KI48

a. VERB 33, ENTER

6.2.21.2.22 Observe on CRT

a. V 06	NO1	Flashing
b. R1		-00090
c. R2		+00090
d. R3		-00135

6.2.21.2.23 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-3.93 ±0.39 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+3.93 ±0.39 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-5.88 ±0.59 degrees

6.2.21.2.24 Insert in KI48

a. VERB 33, ENTER

6.2.21.2.25 Observe on CRT

a. V 06	NO1	Flashing
b. R1		-00135
c. R2		+00135
d. R3		-00160

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6.2.21.2.26 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-5.88 ±0.59 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+5.88 ±0.59 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-6.95 ±0.69 degrees

6.2.21.2.27 Insert in K148

a. VERB 33, ENTER

6.2.21.2.28 Observe on CRT

a. V 06	NO1	Flashing
b. R1		-00160
c. R2		+00160
d. R3		-00384

6.2.21.2.29 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-6.95 ±0.69 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+6.95 ±0.69 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees

6.2.21.2.30 Insert in K148

a. VERB 33, ENTER

6.2.21.2.31 Observe on CRT

a. V 06	NO1	Flashing
b. R1		-00384
c. R2		+00384
d. R3		-00385

6.2.21.2.32 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+16.88 ±1.65 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees

6.2.21.2.33 Insert in K148

a. VERB 33, ENTER

6.2.21.2.34 Observe on CRT

a. V 06	NO1	Flashing
b. R1		-00385
c. R2		+00385
d. R3		+00000

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6.2.21.2.35 Record CRT indications

- | | | |
|------------|-------------------------------|----------------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | -16.88 ±1.65 degrees |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +16.88 ±1.65 degrees |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | 0.00 ±0.19 degrees |

6.2.21.2.36 Insert in K148

- | | | |
|----------|-----|-------|
| a. V 21 | NO1 | ENTER |
| b. 02545 | | ENTER |
| c. 03302 | | ENTER |
| d. V 33 | | ENTER |

6.2.21.2.37 Observe on CRT

- | | | |
|-----------|-----|----------------------|
| a. V 96 | NO3 | Flashing |
| b. NO ATT | | ON |
| c. R1 | | +00000 approximately |
| d. R2 | | +00000 approximately |
| e. R3 | | +00000 approximately |

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6.2.21.3 TVC Test

6.2.21.3.1 The G/N Autopilot Control and SPS Ready discretes shall be applied to the G/N interface.

6.2.21.3.2 Set the OPTICS MODE selector on the Indicator Control panel to MAN.

6.2.21.3.3 Insert in K148

a. VERB 33, ENTER

6.2.21.3.4 Observe on CRT

a. V 01	N 10	Flashing
b. R1		X7373
c. R3		00030

6.2.21.3.5 Insert in K148

a. V 33 ENTER

6.2.21.3.6 Observe on CRT

a. V 01	NOUN 10	Flashing
b. R1		37777
c. R3		00031

6.2.21.3.7 Insert in K148

a. V 33 ENTER

6.2.21.3.8 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00385
c. R2		-00385
d. R3		+00003

6.2.2.3.9 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+16.88 ±1.00 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-16.88 ±1.00 degrees

6.2.21.3.10 Insert in K148

a. VERB 33, ENTER

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6.2.21.3.11 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00384
c. R2		-00384
d. R3		+00003
e. NO ATT		OFF

6.2.21.3.12 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+16.88 ±1.00 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-16.88 ±1.00 degrees

6.2.21.3.13 Insert in KL48

a. VERB 33, ENTER

6.2.21.3.14 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00160
c. R2		-00160
d. R3		+00003

6.2.21.3.15 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+6.95 ±0.41 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-6.95 ±0.41 degrees

6.2.21.3.16 Insert in KL48

a. VERB 33, ENTER

6.2.21.3.17 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00135
c. R2		-00135
d. R3		+00003

6.2.21.3.18 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+5.88 ±0.35 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-5.88 ±0.35 degrees

6.2.21.3.19 Insert in KL48

a. VERB 33, ENTER

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6.2.21.3.20 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00090
c. R2		-00090
d. R3		+00003

6.2.21.3.21 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+3.93 \pm 0.24 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-3.93 \pm 0.24 degrees

6.2.21.3.22 Set the OPTICS CONTROLLER SPEED Switch on the Indicator Control panel to HI.

6.2.21.3.23 Insert in K148

a. VERB 33, ENTER

6.2.21.3.24 Observe on CRT

a. V 08	N 03	Flashing
b. R1		+00000
c. R2		+00000
d. R3		+00003

6.2.21.3.25 While holding the Optics Hand Controller up and left (45°) no longer than 10 seconds, record CRT indications.

a. CG 3722	TRUNNION CDU DAC OUTPUT	0.00 \pm 0.19 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	0.00 \pm 0.19 degrees

6.2.21.3.26 Insert in K148

a. VERB 33, ENTER

6.2.21.3.27 Observe on CRT

a. V 06	N 03	Flashing
b. R1		-00090
c. R2		+00090
d. R3		+00003

6.2.21.3.28 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-3.93 \pm .24 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	+3.93 \pm .24 degrees

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6.2.21.3.29 Set the OPTICS MODE Switch on the Indicator Control panel to ZERO for 30 seconds, then return to MAN.

6.2.21.3.30 Insert in K148

a. VERB 33, ENTER

6.2.21.3.31 Observe on CRT

a. V 96	N 03	Flashing
b. R1		-00135
c. R2		+00135
d. R3		+00003

6.2.21.3.32 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-5.88 ±0.35 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	+5.88 ±0.35 degrees

6.2.21.3.33 Insert in K148

a. VERB 33, ENTER

6.2.21.3.34 Observe on CRT

a. V 96	N 03	Flashing
b. R1		-00160
c. R2		+00160
d. R3		+00003

6.2.21.3.35 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-6.95 ±0.41 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	+6.95 ±0.41 degrees

6.2.21.3.36 Insert in K148

a. VERB 33, ENTER

6.2.21.3.37 Observe on CRT

a. V 96	N 03	Flashing
b. R1		-00384
c. R2		+00384
d. R3		+00003

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6.2.21.3.38 Record CRT indications

- | | | |
|------------|-------------------------|----------------------|
| a. CG 3722 | TRUNNION CDU DAC OUTPUT | -16.88 ±1.00 degrees |
| b. CG 3721 | SHAFT CDU DAC OUTPUT | +16.88 ±1.00 degrees |

6.2.21.3.39 Insert in K148

- a. VERB 33, ENTER

6.2.21.3.40 Observe on CRT

- | | | |
|---------|------|----------|
| a. V 06 | N 03 | Flashing |
| b. R1 | | -00385 |
| c. R2 | | +00385 |
| d. R3 | | +00003 |

6.2.21.3.41 Record CRT indications

- | | | |
|------------|-------------------------|----------------------|
| a. CG 3722 | TRUNNION CDU DAC OUTPUT | -16.88 ±1.00 degrees |
| b. CG 3721 | SHAFT CDU DAC OUTPUT | +16.88 ±1.00 degrees |

6.2.21.3.42 Insert in K148

- | | | |
|-----------|------|-------|
| a. V 34 | | ENTER |
| b. V 40 | N 20 | ENTER |
| c. V 41 | N 20 | ENTER |
| d. +00000 | | ENTER |
| e. +00000 | | ENTER |
| f. +00000 | | ENTER |

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APPENDIX I

Signal	Nomenclature	G&N Test Requirement	PSAAM and/or SCA Uncertainty % of Full Scale
CG 1020	+14 VDC CMC SUPPLY	+14.0 ± 0.4 VDC	0%
CG 1030	+4 VDC CMC SUPPLY	+4.00 ± 0.2 VDC	0%
CG 1040	+120 VDC PIPA SUPPLY	+120 ± 6.0 VDC	1%
CG 1051	+20 VDC PIPA SUPPLY	+20.0 ± 1.2 VDC	0%
CG 1052	-20 VDC PIPA SUPPLY	-20 ± 2 VDC	0%
CG 1070	+4 VDC CIU SUPPLY	+4.0 ± 0.2 VDC	0%
CG 1100	-28 VDC SUPPLY	-27.5 ± 6.0 VDC	0%
CG 1110	2.5 VDC TM BIAS	+2.50 ± 0.05 VDC	0%
CG 1201	IMU 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	1%
CG 1202	IMU 28V .8 KC 5% - 90° RMS	28.0 ± 1.4 VRMS	1.5%
CG 1203	IMU 28V .8KC 0° RMS	28.0 ± 2.1 VRMS	1.5%
CG 1207	PH DIFF IMU 5% 0°, -90°	90 ± 10°	3%
CG 1211	OPTX 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	1.5%
CG 1212	OPTX 28V .8KC 5% -90° RMS	28.00 ± 1.48 VRMS	1.5%
CG 1220	PH DIFF OPTX 1% IMU 1%	0° ± 10°	3%
CG 1331	3.2 KC 28V SUPPLY	28.6 ± 0.56 VRMS	1%
CG 1336	PH DIFF 3.2 KC 28V/CMC SYNC	0° ± 10°	3%
CG 1500	+28 VDC IMU OPERATE BUS	28.8 ± 3VDC	0%
CG 1510	+28 VDC IMU STANDEY BUS	28.8 ± 3 VDC	0%
CG 1520	+28 VDC CMC OPERATE BUS	28.8 ± 3 VDC	0%
CG 1530	+28 VDC OPTX OPERATE BUS	28.8 ± 3 VDC	0%
CG 2001	X PIPA SG O/P	5 VRMS max	3%
CG 2021	Y PIPA SG O/P	5 VRMS max	3%
CG 2041	Z PIPA SG O/P	5 VRMS max	3%
CG 2108	IG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2112	IG 1X RESOLVER O/P SIN	(18.38 ± 1.84)	2.5%
CG 2113	IG 1X RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2117	IG SERVO ERROR IN PHASE	0.0 ± 60mv RMS @ null	2%
CG 2120	IG TORQUE MOTOR CURRENT	0.125 amp max during Fine Alignment Torquing	2%
CG 2138	MG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2142	MG 1X RESOLVER O/P SIN	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2143	MG 1X RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2147	MG SERVO ERROR IN PHASE	0.0 ± 60 mv rms @ null	2%
CG 2150	MG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	2%
CG 2168	OG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2172	OG 1X RESOLVER O/P SIN	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2173	OG 1X RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2177	OG SERVO ERROR IN PHASE	0.0 ± 60mv RMS @ null	2%
CG 2180	OG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	2%

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<u>Signal</u>	<u>Nomenclature</u>	<u>G&N Test Requirement</u>	<u>PSAAM and/or SCA Uncertainty % of Full Scale</u>
CG 2219	PITCH ATT ERROR - CDU DAC O/P	5.06 ± 0.5 VRMS @ 17°	2%
CG 2220	IG CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 2221	IG CDU COARSE ERROR	0.0 ± 0.68 VRMS @null	1%
CG 2249	YAW ATT ERROR-CDU DAC O/P	5.06 ± 0.5VRMS @ 17°	2%
CG 2250	MG CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 2251	MG CDU COARSE ERROR	0.0 ± 0.68VRMS @ null	1%
CG 2279	ROLL ATT ERROR-CDU DAC O/P	5.06 ± 0.5VRMS @17°	2%
CG 2280	OG CDU FINE ERROR	0.0 ± 0.07 VRMS 2 null	1%
CG 2281	OG CDU COARSE ERROR	0.0 ± 0.68 VRMS	1%
CG 2300	PIPA TEMPERATURE	130 ± 1.5°F Operate Mode	0%
CG 3011	TRUNNION CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 3021	SHAFT CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 3117	SXT SHAFT SERVO ERROR IN PH	2' VRMS max	2%
CG 3118	SXT TRUNNION SERVO ERROR IN PHASE	2 VRMS max	2%
CG 3140	SXT SHAFT TACH O/P	3.1 ± 1.1VRMS @ Hi Rate	2%
CG 3145	SXT SHAFT MTR CONTROL WINDING	3.3 ± 1.3VRMS @ Hi Rate	2%
CG 3150	SXT TRUNNION TACH O/P	3.3 ± 1.3VRMS @ Hi Rate	2%
CG 3155	SXT TRUNNION MTR CONTROL WINDING	0.85 ± 0.35VRMS at Hi Rate	2%
CG 3160	SCT SHAFT TACH O/P	3.3 ± 1.3 VRMS @ Hi Rate	2%
CG 3170	SCT TRUNNION TACH O/P	0.85 ± 0.35VRMS @Hi Rate	2%
CG 3721	SHAFT CDU DAC O/P	5.06 ± 0.50VRMS @17°	1%
CG 3722	TRUNNION CDU DAC O/P	5.06 ± 0.50VRMS @ 17°	1%
CG 4300	CMC TEMP	87.8±42.5°F	0%
CG 6020	PIPA CAL MODULE TEMP	72.5±27.5°F	0%
CG 6021	IMU 800 cps 5% TEMP (PSA)	90±30°F	0%
CG 2301	IRIG TEMPERATURE	135 ± 2.5°F in Operate	0%

All uncertainties specified above and those due to instrumentation in the ACE equipment shall be root sum squared with the basic system tolerances to yield an acceptable tolerance for use when testing the G&N System in the spacecraft.

Scope: The following changes are required to make ND1002325 applicable as G&N System technical support documentation for systems containing SUNDIAL C test ropes.

- Change 1: Pages 56 through 61, paragraphs 6.2.9.1.4, 6.2.9.2a, 6.2.9.3a, 6.2.9.5a, 6.2.9.6a, 6.2.9.7a, 6.2.9.8, 6.2.9.10a, 6.2.9.11a, 6.2.9.13a, 6.2.9.15a, 6.2.9.16a, 6.2.9.22. In each of these paragraphs change "VERB 06 NOUN XX flashing" to "VERB 33 NOUN XX flashing."
- Change 2: Pages 106 through 115, paragraphs 6.2.21.2.2a, 6.2.21.2.4a, 6.2.21.2.7a, 6.2.21.2.10a, 6.2.21.2.13a, 6.2.21.2.16a, 6.2.21.2.19a, 6.2.21.2.22a, 6.2.21.2.25a, 6.2.21.2.28a, 6.2.21.2.31a, 6.2.21.2.34a, 6.2.21.2.37a, 6.2.21.3.8a, 6.2.21.3.11a, 6.2.21.3.14a, 6.2.21.3.17a, 6.2.21.3.20a, 6.2.21.3.24a, 6.2.21.3.27a, 6.2.21.3.31a, 6.2.21.3.34a, 6.2.21.3.37a, 6.2.21.3.40a. In each of these steps change "V06" to "V33".

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APOLLO G&N Specification
ND 1002325 REV C

Original Issue Date:
Release Authority: TDRR 31414
Class A Release

POST INSTALLATION CHECKOUT PROCESS
SPECIFICATION FOR THE APOLLO GUIDANCE
AND NAVIGATION SYSTEM -- BLOCK II

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
11/1/66	A	31765	1-116 was 116 pages, now 118 pages.	EA	WLS
1/26/67	B	32784	2, 3, 6, 9, 11, 15, 16, 24, 27, 29, 34, 39	EA	--
			44-50, 54, 56-59, 61-65, 67, 68, 72-74, 76-79, 81-103, 106-117;		
			was 118 pages, now 119 pages.		
2/7/67	C	32919	10-119, Was 119 pages now 124		

This specification consists of page 1 to 124 including Appendix I pages 121, 122 and Addendum I, page 123 and Addendum II, page 124.

APPROVALS	NOT REQUIRED PER CCA-497-0274 NASA/MSC				ROV [Signature] ACED
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APOLLO G&N Specification
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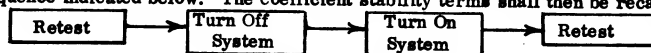
APPROVALS	NOT REQUIRED PER CCA-497-0274 NASA/MSC				ACED
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CODE IDENT. NO. 03953

NUMBER	REVISION LETTER						PAGE

5.4.2 Failure of the D criteria for IRIG and PIPA parameters.

- 5.4.2.1** If D_1 , D_2 , or D_3 exceeds its maximum value as specified in Table D paragraph 6.2.16.10.8 for any IRIG or PIPA, that IRIG or PIPA shall be retested in the sequence indicated below. The coefficient stability terms shall then be recalculated.



RETEST SEQUENCE

If D_1 , D_2 , or D_3 exceeds its maximum value after the retest sequence is completed, the requirements of 5.4.2.2 (IRIG) or 5.4.2.3 (PIPA) shall apply. If D_1 , D_2 , and D_3 are within tolerances specified in Table D after the retest sequence is completed, the original out-of-tolerance D terms calculated in para. 6.2.16.10.8 shall be exonerated.

5.4.2.2 IRIG stability requirements.

- 5.4.2.2.1** Failure to be within the maximum values for D_1 or D_2 or D_3 after the retest sequence shall constitute failure of the unit.

5.4.2.3 PIPA stability requirements.

- 5.4.2.3.1** Failure to be within the maximum limits of D_1 and D_2 after the retest sequence shall constitute failure of the unit.

- 5.4.2.3.2** If the requirements for D_1 and D_2 are met after the retest sequence, but the requirements of D_3 are not met, the PIPA shall be degaussed. After degaussing, the PIPA shall be retested per the sequence indicated in paragraph 5.4.2.1. After voiding the three data points immediately prior to degaussing, the coefficient stability terms shall be recalculated. Failure to meet the D criteria at this time shall constitute failure of the unit.

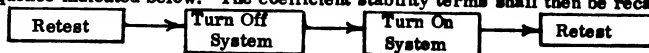
- 5.5** After the defective, replaceable element has been substituted with a flight certified unit, the G&N System checkout sequence shall regress to the rerunning of applicable portions of the selected sequence (by paragraph number) categorized by the sub-assemblies in which the malfunction occurred. The chosen subassembly categories are presented in Table II versus an appropriate retest paragraph sequence. Retest shall be conducted by performing applicable portions of all indicated paragraph numbers in the sequence listed as indicated under the appropriate subassembly heading. Retest shall proceed to the point in the normal test sequence at which the discrepancy was detected and corrected. Normal testing shall continue beyond this point in the specified sequence of Table I.

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RETEST SEQUENCE

If D_1 , D_2 , or D_3 exceeds its maximum value after the retest sequence is completed, the requirements of 5.4.2.2 (IRIG) or 5.4.2.3 (PIPA) shall apply. If D_1 , D_2 , and D_3 are within tolerances specified in Table D after the retest sequence is completed, the original out-of tolerance D terms calculated in para. 6.2.16.10.8 shall be exonerated.

5.4.2.2 IRIG stability requirements.

5.4.2.2.1 Failure to be within the maximum values for D_1 or D_2 or D_3 after the retest sequence shall constitute failure of the unit.

5.4.2.3 PIPA stability requirements.

5.4.2.3.1 Failure to be within the maximum limits of D_1 and D_2 after the retest sequence shall constitute failure of the unit.

5.4.2.3.2 If the requirements for D_1 and D_2 are met after the retest sequence, but the requirements of D_3 are not met, the PIPA shall be degaussed. After degaussing, the PIPA shall be retested per the sequence indicated in paragraph 5.4.2.1. After voiding the three data points immediately prior to degaussing, the coefficient stability terms shall be recalculated. Failure to meet the D criteria at this time shall constitute failure of the unit.

5.5 After the defective, replaceable element has been substituted with a flight certified unit, the G&N System checkout sequence shall regress to the rerunning of applicable portions of the selected sequence (by paragraph number) categorized by the sub-assemblies in which the malfunction occurred. The chosen subassembly categories are presented in Table II versus an appropriate retest paragraph sequence. Retest shall be conducted by performing applicable portions of all indicated paragraph numbers in the sequence listed as indicated under the appropriate subassembly heading. Retest shall proceed to the point in the normal test sequence at which the discrepancy was detected and corrected. Normal testing shall continue beyond this point in the specified sequence of Table I.

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- 5.6 It is assumed that the Test Conductor has a working knowledge of the test equipment used; therefore, this procedure contains only the steps related directly to the G&N System components. If any questions arise concerning the test equipment, the Test Conductor should refer to the pertinent operational manuals.
- 5.7 The following requirements shall be completed before any of the tests in this specification are attempted.
- 5.7.1 The G&N System shall have been qualified in accordance with the requirements of PS2015000.
- 5.7.2 The installation of the G&N System into the spacecraft shall have been completed as specified in Mechanical Installation Specification for Apollo Guidance Equipment Block II, MA0308-0107.
- 5.7.2.1 Interfacing systems (SCS, C & IS, EPS, ECS) shall have been verified to conform to loading and operational requirements as specified by the appropriate ICD.
- 5.7.3 All ACE equipment shall have been qualified in accordance with the respective quality assurance specifications prior to use with the G&N System.

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Paragraph Number	Test Title	RETEST SEQUENCE										INDICATOR CONTROL PANEL
		IMU	NAV BASE	OPTICS	CMC	PSA	LEB DSKY	MDC DSKY	SIGN COND	CDU	G&N HARNESS	PIPA ELECT.
6.1.3	Pre-Power Application Tests	X	X	X	X	X	X	X	X	X	X	X
6.2.1	Application of Standby Power to G&N System	X	X	X	X	X	X	X	X	X	X	X
6.2.5	General Turn OFF and Turn ON Procedure	*	*	*	*	*	*	*	*	*	*	*
6.2.3	Operate Power On Test	X	X	X	X	X	X	X	X	X	X	X
6.2.2	CMC Operational Test	X	X	X	X	X	X	X	X	X	X	X
6.2.8	G&N Panel Brightness and Lamp Test	X	X	X	X	X	X	X	X	X	X	X
6.2.6	G&N Operational Test	X	X	X	X	X	X	X	X	X	X	X
6.2.10	Zero Optics Test	X	X	X	X	X	X	X	X	X	X	X
6.2.13	Optics Slew Rate Test	X	X	X	X	X	X	X	X	X	X	X
6.2.11	Optics Coordinate Transformation Control	X	X	X	X	X	X	X	X	X	X	X
6.2.12	Optics Positional Accuracy Test	X	X	X	X	X	X	X	X	X	X	X
6.2.9	Semi-Automatic Mode Control Test	X	X	X	X	X	X	X	X	X	X	X
6.2.14	Stab Loop Step Response Test	X	X	X	X	X	X	X	X	X	X	X
6.2.15	IRIG Scale Factor Test	X	X	X	X	X	X	X	X	X	X	X
6.2.16	IMU Performance Test	X	X	X	X	X	X	X	X	X	X	X
6.2.17	Fine Alignment Test	X	X	X	X	X	X	X	X	X	X	X
6.2.19	Voltage Margin Test	X	X	X	X	X	X	X	X	X	X	X
6.2.7	Gimbal Friction Test	X	X	X	X	X	X	X	X	X	X	X
6.2.18	Gyrocompassing Test**	X	X	X	X	X	X	X	X	X	X	X
6.2.4	G&N Power Supplies Test	X	X	X	X	X	X	X	X	X	X	X
6.2.21	Spacecraft Control and Displays Test	X	X	X	X	X	X	X	X	X	X	X

* To be used as necessary to turn system on and off.

** If the Gyrocompassing Test is performed as part of a retest activity, it shall be performed for a total of 5 hours including the 2 hour settling period.

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Paragraph Number	Test Title	RETEST SEQUENCE												
		IMU	NAV BASE	OPTICS	CMC	PSA	LEB DSKY	MDC DSKY	SIGN COND	CDU	G&N HARNESS	PIPA ELECT.	INDICATOR CONTROL PANEL	
6.1.3	Pre-Power Application Tests	X	X	X	X	X	X	X	X	X	X	X	X	
6.2.1	Application of Standby Power to G&N System	X	X		X	X	X	X	X	X	X	X		
6.2.5	General Turn OFF and Turn ON Procedure	*	*	*	*	*	*	*	*	*	*	*	*	
6.2.3	Operate Power On Test	X	X		X	X	X	X	X	X	X	X		
6.2.2	CMC Operational Test	X	X		X	X	X	X	X	X	X	X		
6.2.8	G&N Panel Brightness and Lamp Test	X	X	X	X	X	X		X	X	X	X		
6.2.6	G&N Operational Test	X	X	X	X	X	X		X	X	X	X		
6.2.10	Zero Optics Test	X	X	X	X	X	X	X	X	X	X	X		
6.2.13	Optics Slow Rate Test	X	X	X	X	X	X	X	X	X	X	X		
6.2.11	Optics Coordinate Transformation Control	X	X	X	X	X				X				
6.2.12	Optics Positional Accuracy Test		X	X	X	X				X	X			
6.2.9	Semi-Automatic Mode Control Test	X	X	X	X	X	X	X	X	X	X			
6.2.14	Stab Loop Step Response Test	X	X	X	X	X	X	X						
6.2.15	IRIG Scale Factor Test	X	X	X	X	X	X	X						
6.2.16	IMU Performance Test	X	X	X	X	X	X	X						
6.2.17	Fine Alignment Test	X	X	X	X	X								
6.2.19	Voltage Margin Test	X	X	X	X	X				X	X			
6.2.7	Gimbal Friction Test	X	X	X	X	X				X	X			
6.2.18	Gyrocompassing Test**	X	X	X	X				X	X	X			
6.2.4	G&N Power Supplies Test	X	X	X	X	X			X	X	X			
6.2.21	Spacecraft Control and Displays Test	X	X	X	X	X			X	X	X			

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- 5.8 The following conditions are required for testing the G&N System.
- 5.8.1 Spacecraft systems other than the G&N System may be operating on a noninterfering basis while individual system checkout of the G&N System is being conducted.
- 5.8.2 The G&N System shall be supported by the Electrical Power System and Environmental Control System during operation in the Command Module. The Stabilization and Control System shall be connected to the G&N System during G&N operation in the Command Module for passive loading purposes if available.
- 5.8.3 During tests which interface with the Stabilization and Control System and the Central Timing System, operation of these systems shall be required.
- 5.9 The G&N System shall be tested per this specification after it is installed in the spacecraft. In the event that the installed system, or any assembly thereof, is removed from the spacecraft for modification, recycle, or any other reason, this process specification or pertinent portions of it shall be performed after the G&N System or assembly thereof, is reinstalled. Testing shall be limited to G&N System operation while actively connected to qualified spacecraft threshold systems, namely, the Electrical Power System (EPS), Environmental Control System (ECS), and Communication and Instrumentation System (C&IS) as much as possible. However, a minimum of combined and integrated system testing with the Stabilization and Control System (SCS), Central Timing System (CTS) and Caution and Warning System is required for complete G&N System verification.

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- 5.10 The test equipment listed in paragraph 4.1 shall be connected and ready for operation before the tests of this specification are initiated.
- 5.11 Data Records
 - 5.11.1 All data concerning the checkout and operation of the G&N System as monitored via ACE, shall be recorded on the data sheets associated with their corresponding test. Out of tolerance readings shall be recorded and flagged by appropriate symbols.
 - 5.11.1.1 All test data obtained while demonstrating the requirements of this document shall be permanently recorded and forwarded with the tested G&N to the next receiving agency.
 - 5.11.1.2 A record of the amount of time each of the four prime power busses are on shall be kept and forwarded with the G&N to the next receiving agency.
- 5.12 Interface
 - 5.12.1 The APOLLO G&N System shall interface with accepted ECS and EPS distribution systems for power and environment control purposes and with the SCS or SCS substitute system for signal interface in accordance with the applicable ICD's.

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6.0 DETAIL REQUIREMENTS

6.1 Initial Test Conditions

6.1.1 The following precautions shall be observed to preclude loss of continuity in inertial component performance history of the IMU. Deviation may necessitate recalibration of the inertial components.

6.1.1.1 The IMU shall be supplied with heater power on a continuous basis. When S/C Ground Power Supply, Model No. C14-418 is not providing heater power, then heater power shall be supplied through the Inertial Components Temperature Controller (ICTC) Model No. 513-100. The temperature of the IRIG's shall be maintained between 120° and 150°F. The temperature of the PIPA's shall be maintained between 115° and 145°F.

6.1.1.2 The Standby Mode is identified by the circuit breakers IMU HTR MN A, IMU HTR MN B, COMPUTER MN A and MN B in the ON position and IMU MN A and MN B and the G&N Power-IMU switch on LEB Lighting Control Panel in the OFF position. The Operate Mode is identified by the circuit breaker IMU HTR MN A, MN B, COMPUTER MN A and MN B in the ON position and IMU MN A and MN B and the G&N Power-IMU switch on the LEB Lighting Control Panel in the ON position. The G&N System shall be operating in the Standby Mode with CMC power ON for a minimum of two hours prior to advancing to the IMU Operate Mode. In the event Standby or CMC power is interrupted, an equivalent time period shall be allowed when power is restored before advancing to the Operate Mode, except that when the interval of interruption exceeds two hours, a two-hour warmup period shall be mandatory (exceptions to the 2-hour warmup are noted in 6.2.5.2).

6.1.1.3 The Inertial Measurement Unit shall not be without heater power for more than 15 minutes.

6.1.1.4 During the turn on of the G&N power, COMPUTER MN A and MN B and IMU HTR MN A and IMU HTR MN B circuit breakers must be turned on before the IMU MN A and IMU MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. During the turn off of the G&N power the IMU MN A and IMU MN B circuit breakers must be turned off before the IMU HTR MN A and IMU HTR MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. In no case shall COMPUTER MN A and MN B circuit breaker be turned off before IMU MN A and MN B circuit breakers.

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6.1.1.2 The Standby Mode is identified by the circuit breakers IMU HTR MN A, IMU HTR MN B, COMPUTER MN A and MN B in the ON position and IMU MN A and MN B and the G&N Power-IMU switch on LEB Lighting Control Panel in the OFF position. The Operate Mode is identified by the circuit breaker IMU HTR MN A, MN B, COMPUTER MN A and MN B in the ON position and IMU MN A and MN B and the G&N Power-IMU switch on the LEB Lighting Control Panel in the ON position. The G&N System shall be operating in the Standby Mode with CMC power ON for a minimum of two hours prior to advancing to the IMU Operate Mode. In the event Standby or CMC power is interrupted, an equivalent time period shall be allowed when power is restored before advancing to the Operate Mode, except that when the interval of interruption exceeds two hours, a two-hour warmup period shall be mandatory (exceptions to the 2-hour warmup are noted in 6.2.5.2).

6.1.1.3 The Inertial Measurement Unit shall not be without heater power for more than 15 minutes.

6.1.1.4 During the turn on of the G&N power, COMPUTER MN A and MN B and IMU HTR MN A and IMU HTR MN B circuit breakers must be turned on before the IMU MN A and IMU MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. During the turn off of the G&N power the IMU MN A and IMU MN B circuit breakers must be turned off before the IMU HTR MN A and IMU HTR MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. In no case shall COMPUTER MN A and MN B circuit breaker be turned off before IMU MN A and MN B circuit breakers.

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- 6.1.1.5 A warmup period of 1 hour with OPERATE power applied shall be required prior to performing any test in which gyro and accelerometer parameters are measured, and 15 minutes warmup prior to any test in which precision amplitude and frequency power supply checks are made.
- 6.1.1.6 The following Command Module switches shall be in the position shown unless specifically directed otherwise in a procedural function.
- a. UP TIM switches on the LEB G&N Control Panel and MDC Panel 2 shall be set to ACCEPT.
 - b. LAUNCH VEHICLE - GUIDANCE switch on MDC Panel 2 shall be set to IU.
 - c. The SC CONT switch on MDC Panel 1 shall be set to CMC.
 - d. The CMC MODE switch on MDC Panel 1 shall be set to AUTO.
 - e. The Δ V CG switch on MDC Panel 1 shall be set to CSM.
 - f. The TRACKER switch on G&N Indicator Control Panel shall be set to OFF.
 - g. The LIGHTS-INTEGRAL control on the LEB Lighting Control Panel and the Left Hand Circuit Breaker panel shall be set to the minimum brightness - OFF position.
- 6.1.2 The following optical reference alignment requirements shall be demonstrated.
- 6.1.2.1 G&N Installation Qualification Fixture
- 6.1.2.1.1 The SXT Optical Reference No. 1 (Azimuth Autoset) LOS shall be located approximately 40 degrees (CW when viewed from above) from the SCZ axis measured in a horizontal plane. At this position, the Optical Reference shall be capable of being viewed through the SXT ST LOS.
- 6.1.2.1.2 The SXT Optical Reference LOS position with respect to the horizontal plane shall be known to within 5 arc-seconds. The azimuth bearing of the Optical Reference LOS shall be known to within ± 30 minutes of arc.
- 6.1.2.1.3 The SXT Optical Reference No. 2 LOS shall be located approximately 80 degrees from the SXT Optical Reference No. 1 (40 degrees from S/C Z axis) measured in a horizontal plane. At this position, the Optical Reference shall be capable of being viewed through the SXT STAR LOS.

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- 6.1.1.5 A warmup period of 1 hour with OPERATE power applied shall be required prior to performing any test in which gyro and accelerometer parameters are measured, and 15 minutes warmup prior to any test in which precision amplitude and frequency power supply checks are made.
- 6.1.1.6 The following Command Module switches shall be in the position shown unless specifically directed otherwise in a procedural function.
- a. UP TLM switches on the LEB G&N Control Panel and MDC Panel 2 shall be set to ACCEPT.
 - b. LAUNCH VEHICLE - GUIDANCE switch on MDC Panel 2 shall be set to IV.
 - c. The SC CONT switch on MDC Panel 1 shall be set to CMC.
 - d. The CMC MODE switch on MDC Panel 1 shall be set to AUTO.
 - e. The ΔV CG switch on MDC Panel 1 shall be set to CSM.
 - f. The TRACKER switch on G&N Indicator Control Panel shall be set to OFF.
 - g. The LIGHTS-INTEGRAL control on the LEB Lighting Control Panel and the Left Hand Circuit Breaker panel shall be set to the minimum brightness - OFF position.
- 6.1.2 The following optical reference alignment requirements shall be demonstrated.
- 6.1.2.1 G&N Installation Qualification Fixture
- 6.1.2.1.1 The SXT Optical Reference No. 1 (Azimuth Autoset) LOS shall be located approximately 40 degrees (CW when viewed from above) from the SCZ axis measured in a horizontal plane. At this position, the Optical Reference shall be capable of being viewed through the SXT ST LOS.
- 6.1.2.1.2 The SXT Optical Reference LOS position with respect to the horizontal plane shall be known to within 5 arc-seconds. The azimuth bearing of the Optical Reference LOS shall be known to within ± 30 minutes of arc.
- 6.1.2.1.3 The SXT Optical Reference No. 2 LOS shall be located approximately 80 degrees from the SXT Optical Reference No. 1 (40 degrees from S/C Z axis) measured in a horizontal plane. At this position, the Optical Reference shall be capable of being viewed through the SXT STAR LOS.

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- 6.1.2.1.3.1 The SXT optical reference LOS position with respect to the horizontal plane shall be known to within 5 arc-seconds. The SXT optical reference LOS shall be known to within 5 arc-seconds.
- 6.1.2.1.4 SXT Optical Reference No. 3 shall be capable of being viewed through the SXT LLOS and the STAR LOS simultaneously at the Zero Optics position.
- 6.1.2.1.4.1 SXT Optical Reference No. 3 shall have the capability to measure the nonparallelism of the LLOS and STAR LOS to a resolution of 2 arc-seconds.

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- 6.1.2.1.3.1 The SXT optical reference LOS position with respect to the horizontal plane shall be known to within 5 arc-seconds.
- 6.1.2.1.4 SXT Optical Reference No. 3 shall be capable of being viewed through the SXT LLOS and the STAR LOS simultaneously at the Zero Optics position.
- 6.1.2.1.4.1 SXT Optical Reference No. 3 shall have the capability to measure the nonparallelism of the LLOS and STAR LOS to a resolution of 2 arc-seconds.

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6.1.3 Prepower Application Requirements

6.1.3.1 Prior to connecting G&N power connectors 56P30 and 56P31 to spacecraft power connectors C03WLJ345 and C03WLJ346, respectively, it is necessary to perform a complete verification of spacecraft power. Verification shall be performed with the installation of the G&N System complete except for connection of 56P30 and 56P31 to the S/C connectors.

6.1.3.2 Resistance Check on S/C Power Connectors.

6.1.3.2.1 Insure that the following switches and circuit breakers are set to the position indicated.

- a. GUIDANCE/NAVIGATION POWER AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- b. GUIDANCE/NAVIGATION IMU MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- c. GUIDANCE/NAVIGATION IMU HTR MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- d. GUIDANCE/NAVIGATION COMPUTER MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- e. GUIDANCE/NAVIGATION OPTICS MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- f. G/N POWER switch on the Right Hand Circuit Breaker Panel to OFF.
- g. G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.
- h. G/N POWER - IMU switch on the LEB Lighting Control Panel to OFF.

6.1.3.2.2 Obtain GSE tool consisting of connectors, extension cables, and connector terminal test box. Mate connectors P1 and P2 of the extension cables with S/C power connectors C03WLJ345 and C03WLJ346 respectively. Using a VTVM measure the resistance between the terminals listed in Table I. Resistance measurements shall be as specified in Table I.

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6.1.3 Prepower Application Requirements

6.1.3.1 Prior to connecting G&N power connectors 56P30 and 56P31 to spacecraft power connectors CO3WLJ345 and CO3WLJ346, respectively, it is necessary to perform a complete verification of spacecraft power. Verification shall be performed with the installation of the G&N System complete except for connection of 56P30 and 56P31 to the S/C connectors.

6.1.3.2 Resistance Check on S/C Power Connectors.

6.1.3.2.1 Insure that the following switches and circuit breakers are set to the position indicated.

- a. GUIDANCE/NAVIGATION POWER AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- b. GUIDANCE/NAVIGATION IMU MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- c. GUIDANCE/NAVIGATION IMU HTR MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- d. GUIDANCE/NAVIGATION COMPUTER MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- e. GUIDANCE/NAVIGATION OPTICS MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- f. G/N POWER switch on the Right Hand Circuit Breaker Panel to OFF.
- g. G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.
- h. G/N POWER - IMU switch on the LEB Lighting Control Panel to OFF.

6.1.3.2.2 Obtain GSE tool consisting of connectors, extension cables, and connector terminal test box. Mate connectors P1 and P2 of the extension cables with S/C power connectors CO3WLJ345 and CO3WLJ346 respectively. Using a VTVM measure the resistance between the terminals listed in Table I. Resistance measurements shall be as specified in Table I.

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TABLE I. RESISTANCE REQUIREMENTS FOR S/C POWER CONNECTORS

Test No.	From	To	Requirements
1	P1-2	P2-18	Open
2	P1-5		
3	P1-6		
4	P1-7		
5	P1-8		
6	P1-9		
7	P1-10		
8	P1-11		
9	P1-12		
10	P1-13		
11	P1-14		
12	P1-17		
13	P2-2		
14	P2-5		
15	P2-6		
16	P2-7		
17	P2-8		
18	P2-9	P1-18	Continuity
19	P2-10		
20	P2-11		
21	P2-12		
22	P2-13		
23	P2-14		
24	P2-17		
25	P1-1		
26	P1-3		
27	P1-4		
28	P1-15		
29	P1-16		
30	P2-1		
31	P2-3		
32	P2-4		
33	P2-15		
34	P2-16		

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TABLE I. RESISTANCE REQUIREMENTS FOR S/C POWER CONNECTORS

Test No.	From	To	Requirements
1	P1-2	P2-18	Open
2	P1-5		
3	P1-6		
4	P1-7		
5	P1-8		
6	P1-9		
7	P1-10		
8	P1-11		
9	P1-12		
10	P1-13		
11	P1-14		
12	P1-17		
13	P2-2		
14	P2-5		
15	P2-6		
16	P2-7		
17	P2-8		
18	P2-9		
19	P2-10		
20	P2-11		
21	P2-12		
22	P2-13		
23	P2-14		
24	P2-17	P1-18	Continuity
25	P1-1		
26	P1-3		
27	P1-4		
28	P1-15		
29	P1-16		
30	P2-1		
31	P2-3		
32	P2-4		
33	P2-15		
34	P2-16		

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6.1.3.3 Polarity and Voltage Check on S/C Power

6.1.3.3.1 Perform a voltage and polarity check of the G&N S/C power by performing the measurements indicated in Table II. Set the following switches to the position indicated.

- G/N POWER-OPTICS switch on the LEB Lighting Control Panel to ON.
- G/N POWER - IMU switch on the LEB Lighting Control Panel to ON.
- G/N POWER switch on the Right Hand Circuit Breaker Panel to AC1.

For each measurement in Table II set the indicated circuit breaker on the Right Hand Circuit Breaker Panel to ON (breaker pushed in). After each measurement return the circuit breaker to OFF (breaker pulled out).

TABLE II. POLARITY & VOLTAGE REQUIREMENTS
 FOR S/C POWER.

Test No.	Circuit Breaker	Polarity & Connector		Requirements
		Pin No.		
		Low	High	
1	COMPUTER MN A	P1-1	P1-2	+28.8 + 3VDC
2	OPTICS MN A	P1-14	P1-7	+28.8 + 3VDC
3	IMU MN A	P1-15	P1-9	+28.8 + 3VDC
		P1-16	P1-10	+28.8 + 3VDC
4	IMU HTR MN A	P1-3	P1-8	+28.8 + 3VDC
5	COMPUTER MN B	P2-1	P2-2	+28.8 + 3VDC
6	OPTICS MN B	P2-14	P2-7	+28.8 + 3VDC
7	IMU MN B	P2-15	P2-9	+28.8 + 3VDC
		P2-16	P2-10	+28.8 + 3VDC
8	IMU HTR MN B	P2-3	P2-8	+28.8 + 3VDC
9	POWER AC 1	P1-18	P1-17	115 + 10 VAC 400 \pm 7 cps
Set G/N POWER switch on the Right Hand Circuit Breaker Panel to AC 2.				
10	POWER AC 2	P1-18	P1-17	115 + 10VAC 400 + 7 cps

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6.1.3.3 Polarity and Voltage Check on S/C Power

6.1.3.3.1 Perform a voltage and polarity check of the G&N S/C power by performing the measurements indicated in Table II. Set the following switches to the position indicated.

- G/N POWER-OPTICS switch on the LEB Lighting Control Panel to ON.
- G/N POWER - IMU switch on the LEB Lighting Control Panel to ON.
- G/N POWER switch on the Right Hand Circuit Breaker Panel to AC1.

For each measurement in Table II set the indicated circuit breaker on the Right Hand Circuit Breaker Panel to ON (breaker pushed in). After each measurement return the circuit breaker to OFF (breaker pulled out).

TABLE II. POLARITY & VOLTAGE REQUIREMENTS
FOR S/C POWER.

Test No.	Circuit Breaker	Polarity & Connector		Requirements
		Pin No.		
		Low	High	
1	COMPUTER MN A	P1-1	P1-2	+28.8 + 3VDC
2	OPTICS MN A	P1-14	P1-7	+28.8 + 3VDC
3	IMU MN A	P1-15	P1-9	+28.8 + 3VDC
		P1-16	P1-10	+28.8 + 3VDC
4	IMU HTR MN A	P1-3	P1-8	+28.8 + 3VDC
5	COMPUTER MN B	P2-1	P2-2	+28.8 + 3VDC
6	OPTICS MN B	P2-14	P2-7	+28.8 + 3VDC
7	IMU MN B	P2-15	P2-9	+28.8 + 3VDC
		P2-16	P2-10	+28.8 + 3VDC
8	IMU HTR MN B	P2-3	P2-8	+28.8 + 3VDC
9	POWER AC 1	P1-18	P1-17	115 + 10 VAC 400 + 7 cps
Set G/N POWER switch on the Right Hand Circuit Breaker Panel to AC 2.				
10	POWER AC 2	P1-18	P1-17	115 + 10VAC 400 + 7 cps

Set G/N POWER switch on the Right Hand Circuit Breaker Panel to AC 2.

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- 6.1.3.3.2 Verify all circuit breakers exercised in Table II are in the OFF position (breakers pulled out). Set the following switches to the OFF position.
- a. G/N POWER - OPTICS switch on the LEB Lighting Control Panel.
 - b. G/N POWER - IMU switch on the LEB Lighting Control Panel.
 - c. G/N POWER switch on the Right Hand Circuit Breaker Panel.
- 6.1.3.3.3 Disconnect connectors P1 and P2 of the test cables from S/C connectors CO3WLJ345 and CO3WLJ346, respectively.
- 6.1.3.4 Resistance Check on G&N Power Connectors
- 6.1.3.4.1 Connect test cable connectors J1 and J2 to G&N connectors 56P30 and 56P31, respectively. Using a VIVOM, measure the resistance between the terminals listed in Table III. The measurements shall meet the requirements listed in Table III.

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- 6.1.3.3.2 Verify all circuit breakers exercised in Table II are in the OFF position (breakers pulled out). Set the following switches to the OFF position.
- a. G/N POWER - OPTICS switch on the LEB Lighting Control Panel.
 - b. G/N POWER - IMU switch on the LEB Lighting Control Panel.
 - c. G/N POWER switch on the Right Hand Circuit Breaker Panel.
- 6.1.3.3.3 Disconnect connectors P1 and P2 of the test cables from S/C connectors C03WLJ345 and C03WLJ346, respectively.
- 6.1.3.4 Resistance Check on G&N Power Connectors
- 6.1.3.4.1 Connect test cable connectors J1 and J2 to G&N connectors 56P30 and 56P31, respectively. Using a VTVOM, measure the resistance between the terminals listed in Table III. The measurements shall meet the requirements listed in Table III.

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TABLE III. RESISTANCE REQUIREMENTS FOR G&N
 POWER CONNECTORS

Test No.	From	To	Requirements (ohms)	Results
1	J1-15	J1-6	1000 to infinity	
2	J1-15	J1-14	1000 to infinity	
3	J1-15	J1-1	1000 to infinity	
4	J1-15	J1-18	5 meg to infinity	
5	J1-15	J1-16	0.0 to 0.5	
6	J1-15	J1-3	0.0 to 0.5	
7	J1-15	J2-15	0.0 to 0.5	
8	J1-14	J2-14	0.0 to 0.5	
9	J1-1	J2-1	0.0 to 0.5	
10	J1-6	J2-6	0.0 to 0.5	
11	J1-16	J2-16	0.0 to 0.5	
12	J1-3	J2-3	0.0 to 0.5	
13	J1-14	J1-6	1000 to infinity	
14	J1-1	J1-14	1000 to infinity	
15	J1-1	J1-6	0.0 to 2.0 infinity	
16	J1-18	J1-6	5 meg to infinity	
17	J1-18	J1-14	5 meg to infinity	
18	J1-18	J1-1	5 meg to infinity	
19	J1-2	J1-1	2.8 to infinity	
20	J1-9	J1-15	1.1 to infinity	
21	J1-10	J1-16	1.1 to infinity	
22	J1-7	J1-14	2.8 to infinity	
23	J1-8	J1-3	3.7 to infinity	
24	J1-17	J1-18	5 to 20	
25	J2-2	J2-1	2.8 to infinity	
26	J2-9	J2-15	1.1 to infinity	
27	J2-10	J2-16	1.1 to infinity	
28	J2-7	J2-14	2.8 to infinity	
29	J2-8	J2-3	3.7 to infinity	

6.1.3.5 Disconnect the test cable connectors J1 and J2 from G&N power connectors 56P30 and 56P31, respectively. Mate G&N connector 56P30 to S/C connector C03WLJ345 and mate G&N connector 56P31 to S/C connector C03WLJ346. Mate G&N connector 56P32 to S/C connector C03WLJ347.

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TABLE III. RESISTANCE REQUIREMENTS FOR G&N
POWER CONNECTORS

Test No.	From	To	Requirements (ohms)	Results
1	J1-15	J1-6	1000 to infinity	
2	J1-15	J1-14	1000 to infinity	
3	J1-15	J1-1	1000 to infinity	
4	J1-15	J1-18	5 meg to infinity	
5	J1-15	J1-16	0.0 to 0.5	
6	J1-15	J1-3	0.0 to 0.5	
7	J1-15	J2-15	0.0 to 0.5	
8	J1-14	J2-14	0.0 to 0.5	
9	J1-1	J2-1	0.0 to 0.5	
10	J1-6	J2-6	0.0 to 0.5	
11	J1-16	J2-16	0.0 to 0.5	
12	J1-3	J2-3	0.0 to 0.5	
13	J1-14	J1-6	1000 to infinity	
14	J1-1	J1-14	1000 to infinity	
15	J1-1	J1-6	0.0 to 2.0 infinity	
16	J1-18	J1-6	5 meg to infinity	
17	J1-18	J1-14	5 meg to infinity	
18	J1-18	J1-1	5 meg to infinity	
19	J1-2	J1-1	2.8 to infinity	
20	J1-9	J1-15	1.1 to infinity	
21	J1-10	J1-16	1.1 to infinity	
22	J1-7	J1-14	2.8 to infinity	
23	J1-8	J1-3	3.7 to infinity	
24	J1-17	J1-18	5 to 20	
25	J2-2	J2-1	2.8 to infinity	
26	J2-9	J2-15	1.1 to infinity	
27	J2-10	J2-16	1.1 to infinity	
28	J2-7	J2-14	2.8 to infinity	
29	J2-8	J2-3	3.7 to infinity	

6.1.3.5 Disconnect the test cable connectors J1 and J2 from G&N power connectors 56P30 and 56P31, respectively. Mate G&N connector 56P30 to S/C connector C03WLJ345 and mate G&N connector 56P31 to S/C connector C03WLJ346. Mate G&N connector 56P32 to S/C connector C03WLJ347.

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6.1.4 Emergency Shutdown Procedure

CAUTION: In the event of a malfunction occurrence which could damage the G&N System before the normal shutdown procedure 6.2.5 could be performed, the following sequence should be utilized in the spacecraft.

- 6.1.4.1** On the LEB Lighting Control Panel set the G/N POWER-IMU and G/N POWER - OPTICS switches to OFF.
- 6.1.4.2** On the Right Hand Circuit Breaker Panel set the following switches and circuit breakers to OFF (breakers pulled out).
- a. GUIDANCE/NAVIGATION COMPUTER MN A and MN B
 - b. GUIDANCE/NAVIGATION IMU HTR MN A and MN B
 - c. G/N POWER switch to OFF
 - d. GUIDANCE/NAVIGATION IMU MN A and MN B
 - e. GUIDANCE/NAVIGATION OPTICS MN A and MN B
 - f. GUIDANCE/NAVIGATION POWER AC 1 and AC 2
- 6.1.4.3** Verify that the ICTC is providing heater power to the G&N System.

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6.1.4 Emergency Shutdown Procedure

CAUTION: In the event of a malfunction occurrence which could damage the G&N System before the normal shutdown procedure 6.2.5 could be performed, the following sequence should be utilized in the spacecraft.

- 6.1.4.1 On the LEB Lighting Control Panel set the G/N POWER-IMU and G/N POWER - OPTICS switches to OFF.
- 6.1.4.2 On the Right Hand Circuit Breaker Panel set the following switches and circuit breakers to OFF (breakers pulled out).
 - a. GUIDANCE/NAVIGATION COMPUTER MN A and MN B
 - b. GUIDANCE/NAVIGATION IMU HTR MN A and MN B
 - c. G/N POWER switch to OFF
 - d. GUIDANCE/NAVIGATION IMU MN A and MN B
 - e. GUIDANCE/NAVIGATION OPTICS MN A and MN B
 - f. GUIDANCE/NAVIGATION POWER AC 1 and AC 2
- 6.1.4.3 Verify that the ICTC is providing heater power to the G&N System.

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- 6.2 Test Procedures
- 6.2.1 Application of Standby Power to G & N System
- 6.2.1.1 Verify that spacecraft power checks, to include polarity and magnitude on Spacecraft Power Connector, have been made as specified in 6.1.3.
- 6.2.1.2 All power and control switches on the G & N Indicator Control Panel shall be placed in the OFF or neutral position.
- 6.2.1.3 The Inertial Component Temperature Controller (ICTC), shall be supplying inertial component heater power to the G & N System through the PSA, Connector No. 45J2.
- 6.2.1.4 Computer Power On
- 6.2.1.4.1 Set G & N COMPUTER MN A and MN B Breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in).
- 6.2.1.4.2 Set the POWER-AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in), and position G/N POWER switch to AC1.
- 6.2.1.4.3 Set the computer numerical display lights to the minimum acceptable brightness by rotating the BRIGHTNESS Controls on the MDC and LEB Lighting Control Panels.
- 6.2.1.4.4 The CMC +28 VDC power discrete shall be issued (CG 1523). This can be observed by the lighted CMC +28 VDC operate lamp on the Event Module. The +28 VDC CMC OPERATE voltage (CG 1520) shall be $+28.8 \pm 3$ VDC. Verify CRT indication.
- 6.2.1.4.5 Using DSKY, enter VERB 36, EWTR, then press RESET. All computer alarms on the Main Display Console (MDC), LEB CMC DSKY and CRT shall clear.
- 6.2.1.4.6 The voltage output of the +4 VDC CMC supply shall be $+4.00 \pm 0.20$ VDC, (CG 1030). The value on the CRT shall be recorded.
- 6.2.1.4.7 The voltage output of the +14 VDC CMC supply shall be $+14.0 \pm 0.4$ VDC, (CG 1020). The value on the CRT shall be recorded.
- 6.2.1.4.8 Verify that the CMC is in the Backup Mode by monitoring on the CRT that the Program indicates 00, and the program readouts on the MDC and LEB AGC DSKY indicate 00.

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6.2 Test Procedures

6.2.1 Application of Standby Power to G & N System

6.2.1.1 Verify that spacecraft power checks, to include polarity and magnitude on Spacecraft Power Connector, have been made as specified in 6.1.3.

6.2.1.2 All power and control switches on the G & N Indicator Control Panel shall be placed in the OFF or neutral position.

6.2.1.3 The Inertial Component Temperature Controller (ICTC), shall be supplying inertial component heater power to the G & N System through the PSA, Connector No. 45J2.

6.2.1.4 Computer Power On

6.2.1.4.1 Set G & N COMPUTER MN A and MN B Breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in).

6.2.1.4.2 Set the POWER-AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in), and position G/N POWER switch to AC1.

6.2.1.4.3 Set the computer numerical display lights to the minimum acceptable brightness by rotating the BRIGHTNESS Controls on the MDC and LEB Lighting Control Panels.

6.2.1.4.4 The CMC +28 VDC power discrete shall be issued (CG 1523). This can be observed by the lighted CMC +28 VDC operate lamp on the Event Module. The +28 VDC CMC OPERATE voltage (CG 1520) shall be $\pm 28.8 \pm 3$ VDC. Verify CRT indication.

6.2.1.4.5 Using DSKY, enter VERB 36, ENTER, then press RESET. All computer alarms on the Main Display Console (MDC), LEB CMC DSKY and CRT shall clear.

6.2.1.4.6 The voltage output of the +4 VDC CMC supply shall be $\pm 4.00 \pm 0.20$ VDC, (CG 1030). The value on the CRT shall be recorded.

6.2.1.4.7 The voltage output of the +14 VDC CMC supply shall be $\pm 14.0 \pm 0.4$ VDC, (CG 1020). The value on the CRT shall be recorded.

6.2.1.4.8 Verify that the CMC is in the Backup Mode by monitoring on the CRT that the Program indicates 00, and the program readouts on the MDC and LEB AGC DSKY indicate 00.

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6.2.1.4.9 Zero the CMC erasable memory by entering the following sequence into the K-start:

- a. VERB 57, ENTER
- b. 00015, ENTER

6.2.1.4.10 Initiate CMC self-check by entering the following sequence into the K-start:

- a. VERB 21, NOUN 27 ENTER
- b. 77777, ENTER
- c. VERB 15 NOUN 01 ENTER
- d. 1366, ENTER

6.2.1.4.10.1 Monitor DSKY until R3 (SCOUNT +2) increments twice. If an error is detected, the following will be displayed:

R1 = 01102
R2 = XXXXX C (SFAL)
R3 = XXXXX C (ERCOUNT)

6.2.1.4.10.2 Enter the following into the K-start:

- a. VERB 21
- b. NOUN 27, press ENTER pushbutton
- c. 00000, press ENTER pushbutton

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6.2.1.4.9 Zero the CMC erasable memory by entering the following sequence into the K-start:

- a. VERB 57, ENTER
- b. 00015, ENTER

6.2.1.4.10 Initiate CMC self-check by entering the following sequence into the K-start:

- a. VERB 21, NOUN 27 ENTER
- b. 77777, ENTER
- c. VERB 15 NOUN 01 ENTER
- d. 1366, ENTER

6.2.1.4.10.1 Monitor DSKY until R3 (SCOUNT +2) increments twice. If an error is detected, the following will be displayed:

R1 = 01102
R2 = XXXXX C (SFAIL)
R3 = XXXXX C (ERCOUNT)

6.2.1.4.10.2 Enter the following into the K-start:

- a. VERB 21
- b. NOUN 27, press ENTER pushbutton
- c. 00000, press ENTER pushbutton

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6.2.1.5 IMU HTR Heater Power On

6.2.1.5.1 Enter the IMU Standby Mode of operation by engaging the IMU HTR MN A and MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).

6.2.1.5.2 Verify that the IMU +28 VDC STANDBY discrete lamp on Event Module is illuminated (CG 1513).

6.2.1.5.3 Record the value of the following signals displayed on the CRT.

Signal	Requirement
a. CG 1331 28V 3200 CPS POWER SUPPLY FEEDBACK	28.6 ± 0.6 VRMS
b. CG 1510 + 28 VDC STANDBY POWER	28.8 (±3) VDC

6.2.1.5.4 The PIPA TEMP on the CRT shall be monitored at 15 min., 1 hr. and 2 hrs. from execution of 6.2.1.5.2 to insure that the PIPA Temperature Control Loop circuitry is operating to maintain a temperature of $130.5 \pm 1.5^\circ\text{F}$ (CG 2300).

6.2.1.5.5 The IRIG TEMP on the CRT shall be monitored at 15 min., 1 hr., and 2 hrs. after 6.2.1.5.2 is executed to insure that the IRIG Temperature (CG 2301) is within 3.0 degrees of the PIPA Temperature.

6.2.1.5.6 At the termination of the 2-hour period, record the PIPA Temperature (CG 2300) and the IRIG Temperature (CG 2301) on the CRT.

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6.2.1.5 IMU HTR Heater Power On

6.2.1.5.1 Enter the IMU Standby Mode of operation by engaging the IMU HTR MN A and MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).

6.2.1.5.2 Verify that the IMU +28 VDC STANDBY discrete lamp on Event Module is illuminated (CG 1513).

6.2.1.5.3 Record the value of the following signals displayed on the CRT.

Signal	Requirement
a. CG 1331 28V 3200 CPS POWER SUPPLY FEEDBACK	28.6 ± 0.6 VRMS
b. CG 1510 + 28 VDC STANDBY POWER	28.8 (±3) VDC

6.2.1.5.4 The PIPA TEMP on the CRT shall be monitored at 15 min., 1 hr. and 2 hrs. from execution of 6.2.1.5.2 to insure that the PIPA Temperature Control Loop circuitry is operating to maintain a temperature of 130.5 ± 1.5F (CG 2300).

6.2.1.5.5 The IRIG TEMP on the CRT shall be monitored at 15 min., 1 hr., and 2 hrs. after 6.2.1.5.2 is executed to insure that the IRIG Temperature (CG 2301) is within 3.0 degrees of the PIPA Temperature.

6.2.1.5.6 At the termination of the 2-hour period, record the PIPA Temperature (CG 2300) and the IRIG Temperature (CG 2301) on the CRT.

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6.2.2 CMC Operational Test

NOTE: This test shall be performed when only IMU HTR and Computer Power is applied. The test shall not be performed when IMU OPERATE power is applied.

6.2.2.1 Verify that IMU STANDBY power (including CMC operate power) is applied, IMU OPERATE power is not applied. (G & N IMU HTR MN A and MN B breakers engaged, Computer MN A and MN B breakers engaged, IMU MN A and MN B breakers disengaged, G/N Power-IMU switch on LEB Lighting Control Panel in OFF Position).

6.2.2.1.1 Using the LEB CMC DSKY, enter VERB 36, ENTR then press RESET.

6.2.2 CMC Checks

6.2.2.1 Using the LEB CMC DSKY, enter the following sequence of data into the CMC to initiate the DSKY check. Press the ENTER pushbutton after each entry (denoted by E).

VERB 21 NOUN 27, E
 77766, E

6.2.2.2 DSKY check shall check all the electroluminescent elements by displaying the decimal numbers from nine through zero in succession, each set of numbers shall be displayed for approximately 5 seconds. Verify all elements operable on MDC and LEB CMC DSKY's. VERB-NOUN display shall flash.

6.2.2.2.1 Minus and plus signs shall be displayed. Verify operation on MDC and LEB DSKY's.

6.2.2.2.2 COMP ACTY lamp shall be illuminated for approximately 5 seconds, then DSKY shall blank.

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6.2.2 CMC Operational Test

NOTE: This test shall be performed when only IMU HTR and Computer Power is applied. The test shall not be performed when IMU OPERATE power is applied.

6.2.2.1 Verify that IMU STANDBY power (including CMC operate power) is applied, IMU OPERATE power is not applied. (G & N IMU HTR MN A and MN B breakers engaged, Computer MN A and MN B breakers engaged, IMU MN A and MN B breakers disengaged, G/N Power-IMU switch on LEB Lighting Control Panel in OFF Position).

6.2.2.1.1 Using the LEB CMC DSKY, enter VERB 36, ENTR then press RESET.

6.2.2 CMC Checks

6.2.2.1 Using the LEB CMC DSKY, enter the following sequence of data into the CMC to initiate the LSKY check. Press the ENTER pushbutton after each entry (denoted by E).

VERB 21 NOUN 27, E
77766, E

6.2.2.2 DSKY check shall check all the electroluminescent elements by displaying the decimal numbers from nine through zero in succession, each set of numbers shall be displayed for approximately 5 seconds. Verify all elements operable on MDC and LEB CMC DSKY's. VERB-NOUN display shall flash.

6.2.2.2.1 Minus and plus signs shall be displayed. Verify operation on MDC and LEB DSKY's.

6.2.2.2.2 COMP ACTY lamp shall be illuminated for approximately 5 seconds, then DSKY shall blank.

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6.2.2.3 CAUTION and STATUS Displays

6.2.2.3.1 Enter VERB 35, ENVR, into LEB CMC DSKY.

6.2.2.3.2 The following MDC and LEB CMC DSKY displays shall illuminate for approximately 5 seconds.

- a. UPLINK ACTY
- b. NO ATF
- c. STBY
- d. KEY REL Flashing
- e. TEMP
- f. GIMBAL LOCK
- g. PROG
- h. RESTART
- i. TRACKER
- j. OPR ERROR Flashing
- k. COMP ACTY
- l. VERB-NOUN Flashing
- m. Plus 88888 in R1, R2, and R3
- n. PGNS, CMC, and ISS caution lights. (CMC caution shall remain illuminated for approximately 60 seconds.)

After indications a through l go out +88888 shall remain in R1, R2, R3.

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6.2.2.3 CAUTION and STATUS Displays

6.2.2.3.1 Enter VERB 35, ENIR, into LEB CMC DSKY.

6.2.2.3.2 The following MDC and LEB CMC DSKY displays shall illuminate for approximately 5 seconds.

- a. UPLINK ACTY
- b. NO ATT
- c. STBY
- d. KEY REL Flashing
- e. TEMP
- f. GIMBAL LOCK
- g. PROG
- h. RESTART
- i. TRACKER
- j. OPR ERROR Flashing
- k. COMP ACTY
- l. VERB-NOUN Flashing
- m. Plus 88888 in R1, R2, and R3
- n. PGNS, CMC, and ISS caution lights. (CMC caution shall remain illuminated for approximately 60 seconds.)

After indications a through l go out +88888 shall remain in R1, R2, R3.

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6.2.2.4 DSKY Pushbutton Check

- 6.2.2.4.1 Enter the following sequence into the LEB CMC DSKY. Press the ENTER pushbutton after each entry (denoted by E).
 - a. VERB 25 NOUN 01, E
 - b. 01600, E
 - c. +00123, E
 - d. -00456, E
 - e. -00789, E
- 6.2.2.4.2 The LEB CMC DSKY shall indicate +00123 in R1, -00456 in R2, and -00789 in R3.
- 6.2.2.4.3 Enter VERB 05, NOUN 01 into the LEB CMC DSKY. Press the ENTER pushbutton.
- 6.2.2.4.4 Enter 01600 into LEB CMC DSKY. Press the ENTER pushbutton. The LEB CMC DSKY shall indicate 00024 in R1, 77664 in R2, and 77576 in R3. Verify.
- 6.2.2.4.5 Repeat of 6.2.2.4.1 through 6.2.2.4.4 using the MDC CMC DSKY. The results shall be as specified in 6.2.2.4.4.

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6.2.2.4 DSKY Pushbutton Check

6.2.2.4.1 Enter the following sequence into the LEB CMC DSKY. Press the ENTER pushbutton after each entry (denoted by E).

- a. VERB 25 NOUN 01, E
- b. 01600, E
- c. +00123, E
- d. -00456, E
- e. -00789, E

6.2.2.4.2 The LEB CMC DSKY shall indicate +00123 in R1, -00456 in R2, and -00789 in R3.

6.2.2.4.3 Enter VERB 05, NOUN 01 into the LEB CMC DSKY. Press the ENTER pushbutton.

6.2.2.4.4 Enter 01600 into LEB CMC DSKY. Press the ENTER pushbutton. The LEB CMC DSKY shall indicate 00024 in R1, 77664 in R2, and 77576 in R3. Verify.

6.2.2.4.5 Repeat of 6.2.2.4.1 through 6.2.2.4.4 using the MDC CMC DSKY. The results shall be as specified in 6.2.2.4.4.

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- 6.2.2.5 Uplink and Downlink Checks.
- 6.2.2.5.1 Enter VERB 36 into K148. Press the ENTER pushbutton, then press ERROR RESET pushbutton.
- 6.2.2.5.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.
- a. VERB 25 NOUN 01 ENTER
 - b. 01600, ENTER
 - c. 00000, ENTER
 - d. 77777, ENTER
 - e. 07254, ENTER
 - f. VERB 05 NOUN 01, ENTER
 - g. 01600, ENTER
- 6.2.2.5.3 CMC Registers R1, R2, and R3 display on the CRT shall indicate 00000, 77777, and 07254, respectively.
- 6.2.2.6 CMC Automatic Self-Test
- 6.2.2.6.1 Initiate CMC Self-Test by entering the following sequence into the K-Start.
- a. VERB 21 NOUN 27, ENTER
 - b. 77777, ENTER
 - c. VERB 15 NOUN 01, ENTER
 - d. 1366, ENTER
- 6.2.2.6.2 Monitor DSKY until R3 (SCOUNT+2) increments twice. If an error is detected, the following will be displayed.
- a. VERB 05 NOUN 31
 - b. R1 = 01102
 - c. R2 = XXXXX c (SFAL)
 - d. R3 = XXXXX c (ERCOUNT)
- 6.2.2.6.3 Terminate Self-Test by entering the following into the K-Start.
- a. VERB 21 NOUN 27, ENTER
 - b. 00000, ENTER

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- 6.2.2.5 Uplink and Downlink Checks.
- 6.2.2.5.1 Enter VERB 36 into K148. Press the ENTER pushbutton, then press ERROR RESET pushbutton.
- 6.2.2.5.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.
- a. VERB 25 NOUN 01 ENTER
 - b. 01600, ENTER
 - c. 00000, ENTER
 - d. 77777, ENTER
 - e. 07254, ENTER
 - f. VERB 05 NOUN 01, ENTER
 - g. 01600, ENTER
- 6.2.2.5.3 CMC Registers R1, R2, and R3 display on the CRT shall indicate 00000, 77777, and 07254, respectively.
- 6.2.2.6 CMC Automatic Self-Test
- 6.2.2.6.1 Initiates CMC Self-Test by entering the following sequence into the K-Start.
- a. VERB 21 NOUN 27, ENTER
 - b. 77777, ENTER
 - c. VERB 15 NOUN 01, ENTER
 - d. 1366, ENTER
- 6.2.2.6.2 Monitor DSKY until R3 (SCOUNT+2) increments twice. If an error is detected, the following will be displayed.
- a. VERB 05 NOUN 31
 - b. R1 = 01102
 - c. R2 = XXXXX c (SFAL)
 - d. R3 = XXXXX c (ERCOUNT)
- 6.2.2.6.3 Terminate Self-Test by entering the following into the K-Start.
- a. VERB 21 NOUN 27, ENTER
 - b. 00000, ENTER

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6.2.2.7 Parity Fail Test

6.2.2.7.1 Enter the following into the K-Start. Press the ENTER pushbutton after each entry.

- a. VERB 57, ENTER
- b. 00015, ENTER
- c. VERB 21 NOUN 02, ENTER
- d. 01600, ENTER
- e. 33777, ENTER
- f. VERB 25 NOUN 26, ENTER
- g. 04000, ENTER
- h. 01600, ENTER
- i. 00003, ENTER
- j. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate.
The FGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.7.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & FGNS caution lamps shall extinguish.

6.2.2.7.3 Enter VERB 36, into the K-START. Press the ENTER pushbutton.

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6.2.2.7 Parity Fail Test

6.2.2.7.1 Enter the following into the K-Start. Press the ENTER pushbutton after each entry.

- a. VERB 57, ENTER
- b. 00015, ENTER
- c. VERB 21 NOUN 02, ENTER
- d. 01600, ENTER
- e. 33777, ENTER
- f. VERB 25 NOUN 26, ENTER
- g. 04000, ENTER
- h. 01600, ENTER
- i. 00003, ENTER
- j. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate.
The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.7.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.7.3 Enter VERB 36, into the K-START. Press the ENTER pushbutton.

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6.2.2.8 Rupt Lock Test

6.2.2.8.1 Enter the following sequence into the K-Start. Press the ENTER pushbutton after each entry.

- a. VERB 24 NOUN 01, ENTER
- b. 01600, ENTER
- c. 30001, ENTER
- d. 01600, ENTER
- e. VERB 25 NOUN 26, ENTER
- f. 00001, ENTER
- g. 01600, ENTER
- h. 00003, ENTER
- i. VERB 31, ENTER

The RESTART lamps on the MDC and LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.8.2 Press the ERROR RESET pushbutton on the K-START. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.8.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

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6.2.2.8 Rupt Lock Test

6.2.2.8.1 Enter the following sequence into the K-Start. Press the ENTER pushbutton after each entry.

- a. VERB 24 NOUN 01, ENTER
- b. 01600, ENTER
- c. 30001, ENTER
- d. 01600, ENTER
- e. VERB 25 NOUN 26, ENTER
- f. 00001, ENTER
- g. 01600, ENTER
- h. 00003, ENTER
- i. VERB 31, ENTER

The RESTART lamps on the MDC and LEB DSKY's shall illuminate.
The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.8.2 Press the ERROR RESET pushbutton on the K-START. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.8.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

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6.2.2.9 TC Trap Test

6.2.2.9.1 Enter the following sequence into the K-Start. Press the ENTER pushbutton after each entry.

- a. VERB 21 NOUN 02, ENTER
- b. 01600, ENTER
- c. 01600, ENTER
- d. VERB 25 NOUN 26, ENTER
- e. 04000, ENTER
- f. 01600, ENTER
- g. 00003, ENTER
- h. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.9.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.9.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

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6.2.2.9 TC Trap Test

6.2.2.9.1 Enter the following sequence into the K-Start. Press the ENTER pushbutton after each entry.

- a. VERB 21 NOUN 02, ENTER
- b. 01600, ENTER
- c. 01600, ENTER
- d. VERB 25 NOUN 26, ENTER
- e. 04000, ENTER
- f. 01600, ENTER
- g. 00003, ENTER
- h. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.9.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.9.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

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6.2.2.10 Nightwatchman Test

6.2.2.10.1 Enter the following sequence into the K-Start. Press **ENTER** pushbutton after each entry.

- a. VERB 24 NOUN 01, **ENTER**
- b. 01600, **ENTER**
- c. 30001, **ENTER**
- d. 01600, **ENTER**
- e. VERB 25 NOUN 26, **ENTER**
- f. 04000, **ENTER**
- g. 01600, **ENTER**
- h. 00003, **ENTER**
- i. VERB 30, **ENTER**

The **RESTART** lamps on the MDC & LEB DSKY's shall illuminate. The **PGNS** caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on MDC and LEB CMC DSKY and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.10.2 Press the **ERROR RESET** pushbutton on the K-Start. The **RESTART** & **PGNS** caution lamps shall extinguish.

6.2.2.10.3 Enter VERB 36 into the K-Start. Press the **ENTER** pushbutton.

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6.2.2.10 Nightwatchman Test

6.2.2.10.1 Enter the following sequence into the K-Start. Press ENTER pushbutton after each entry.

- a. VERB 24 NOUN 01, ENTER
- b. 01600, ENTER
- c. 30001, ENTER
- d. 01600, ENTER
- e. VERB 25 NOUN 26, ENTER
- f. 04000, ENTER
- g. 01600, ENTER
- h. 00003, ENTER
- i. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on MDC and LEB CMC DSKY and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.10.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.10.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

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- 6.2.2.11 CMC Clock Frequency Test
 - 6.2.2.11.1 Insure that the CMC has been operating for at least 15 min. before performing this test.
 - 6.2.2.11.2 Insure that the IMU 3.2 kc 28 V Supply is available on the vertical input to PIPA Scope.
 - 6.2.2.11.3 Insure that the EPUT Meter and preset counter plug-in unit are connected to 115V, 60 cps power.
 - 6.2.2.11.3.1 Permit the EPUT to warm up for the length of time required by the manufacturer's specification.
 - 6.2.2.11.4 Connect the signal output from Oscilloscope 4A4-A1 to the input channel on the EPUT Meter.
 - 6.2.2.11.5 Set the preset counter to indicate 96000.
 - 6.2.2.11.6 Set the EPUT meter to count at the maximum count rate (1 megacycle or greater).
 - 6.2.2.11.7 Adjust the Trigger Level to the point midway between the range over which the counter will normally count.
 - 6.2.2.11.8 Each count cycle shall last approximately 30 seconds. Adjust the display time to permit recording the display on the EPUT.
 - 6.2.2.11.9 Record the results of 10 count-cycles. Calculate the average time per cycle over the 10 cycles. Record the result.
 - 6.2.2.11.10 Divide 96000 by the average time from 6.2.2.11.9. Record the result as 3200 cps frequency.
 - 6.2.2.11.11 Multiply the 3200 cps frequency by 640. Record the result as the CMC clock frequency.
 - 6.2.2.11.11.1 The CMC Clock Frequency shall be 2048000 ± 5 cps.

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- 6.2.2.11 CMC Clock Frequency Test
 - 6.2.2.11.1 Insure that the CMC has been operating for at least 15 min. before performing this test.
 - 6.2.2.11.2 Insure that the IMU 3.2 kc 28 V Supply is available on the vertical input to PIPA Scope.
 - 6.2.2.11.3 Insure that the EPUT Meter and preset counter plug-in unit are connected to 115V, 60 cps power.
 - 6.2.2.11.3.1 Permit the EPUT to warm up for the length of time required by the manufacturer's specification.
 - 6.2.2.11.4 Connect the signal output from Oscilloscope 4A4-A1 to the input channel on the EPUT Meter.
 - 6.2.2.11.5 Set the preset counter to indicate 96000.
 - 6.2.2.11.6 Set the EPUT meter to count at the maximum count rate (1 megacycle or greater).
 - 6.2.2.11.7 Adjust the Trigger Level to the point midway between the range over which the counter will normally count.
 - 6.2.2.11.8 Each count cycle shall last approximately 30 seconds. Adjust the display time to permit recording the display on the EPUT.
 - 6.2.2.11.9 Record the results of 10 count-cycles. Calculate the average time per cycle over the 10 cycles. Record the result.
 - 6.2.2.11.10 Divide 96000 by the average time from 6.2.2.11.9. Record the result as 3200 cps frequency.
 - 6.2.2.11.11 Multiply the 3200 cps frequency by 640. Record the result as the CMCClock frequency.
 - 6.2.2.11.11.1 The CMCClock Frequency shall be 2048000 ± 5 cps.

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6.2.3 Operate Power On Test

6.2.3.1 IMU Operate Power On

CAUTION: The sequences specified in this test must be adhered to. Deviations may necessitate recalibration of the inertial components.

NOTE: Disregard the GIMBAL LOCK indicator until the completion of step 6.2.3.1.6.

6.2.3.1.1 The following Command Module switches and circuit breakers shall be in the following state:

Right Hand Circuit Breaker Panel

- a. GUIDANCE/NAVIGATION COMPUTER MN A and MN B breakers on (pushed in)
- b. GUIDANCE/NAVIGATION IMU HTR MN A and MN B breakers on (pushed in)
- c. GUIDANCE/NAVIGATION IMU MN A and MN B breakers off (pulled out)
- d. GUIDANCE/NAVIGATION OPTICS MN A and MN B breakers off (pulled out)

LEB Lighting Control Panel

- e. G/N Power - IMU set to OFF
- f. G/N Power - Optics set to OFF

6.2.3.1.2 Switches and selectors on the G & N Indicator control panel shall be set as follows:

- a. OPTICS MODE to MANUAL
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to MED
- d. TELESCOPE TRUNNION to SLAVE to SXT
- e. RETICLE BRIGHTNESS to minimum brightness position

6.2.3.1.3 Adjust the Command Module MDC and LEB Lighting Controls to minimum intensity for proper readout of G & N Displays.

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6.2.3 Operate Power On Test

6.2.3.1 IMU Operate Power On

CAUTION: The sequences specified in this test must be adhered to. Deviations may necessitate recalibration of the inertial components.

NOTE: Disregard the GIMBAL LOCK indicator until the completion of step 6.2.3.1.6.

6.2.3.1.1 The following Command Module switches and circuit breakers shall be in the following state:

Right Hand Circuit Breaker Panel

- a. GUIDANCE/NAVIGATION COMPUTER MN A and MN B breakers on (pushed in)
- b. GUIDANCE/NAVIGATION IMU HTR MN A and MN B breakers on (pushed in)
- c. GUIDANCE/NAVIGATION IMU MN A and MN B breakers off (pulled out)
- d. GUIDANCE/NAVIGATION OPTICS MN A and MN B breakers off (pulled out)

LES Lighting Control Panel

- e. G/N Power - IMU set to OFF
- f. G/N Power - Optics set to OFF

6.2.3.1.2 Switches and selectors on the G & N Indicator control panel shall be set as follows:

- a. OPTICS MODE to MANUAL
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to MED
- d. TELESCOPE TRUNNION to SLAVE to SXT
- e. RETICLE BRIGHTNESS to minimum brightness position

6.2.3.1.3 Adjust the Command Module MDC and LES Lighting Controls to minimum intensity for proper readout of G & N Displays.

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6.2.3.1.4 Set up the ACE analog recorders to monitor the following measurements (set chart speed to 5 mm/sec):

- a. CG 2117 IGA Servo Error In Phase
- b. CG 2177 OGA Servo Error In Phase
- c. CG 2147 MGA Servo Error In Phase
- d. CG 2112 IG IX Resolver Output Sin
- e. CG 2172 OG IX Resolver Output Sin
- f. CG 2142 MG IX Resolver Output Sin
- g. CG 1040 +120 VDC PIPA Supply DC Level

CAUTION: Before proceeding, insure that the G & N System has been operating in the STANDBY MODE (power configuration as defined in 6.2.3.1) for a minimum period of 2 hours. Exceptions to this requirement are noted in 6.2.5.2.9.

CAUTION NOTE: If the requirements of 6.2.3.1.6 are not met, remove IMU operate power immediately by placing the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

6.2.3.1.5 Perform the following sequence:

- a. Turn on the IMU MN A and MN B circuit breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).
- b. Start Analog Recorders.
- c. Place G/N Power - IMU switch on the LEB Lighting Control Panel to IMU (switch toggle up).

6.2.3.1.6 Immediately begin monitoring the following measurements.

- a. The IMU Operate Power is $\pm 28.8 \pm 3$ VDC (CG 1500). Verify on CRT.
- b. On the recorders, verify that oscillations are not sustained and that a null is achieved within 10 seconds of power application in 6.2.3.1.5 on the following measurements:

CG 2112, IG IX Resolver Output Sin
CG 2142, MG IX Resolver Output Sin
CG 2172, OG IX Resolver Output Sin

- c. On the CRT, verify the absence of the +120 VDC PIPA supply (CG 1040) for a period of 90 + 10 seconds following power application in 6.2.3.1.5. After approximately 100 seconds, the voltage shall read $\pm 120 \pm 6$ VDC.

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6.2.3.1.4 Set up the ACE analog recorders to monitor the following measurements (set chart speed to 5 mm/sec):

- a. CG 2117 IGA Servo Error In Phase
- b. CG 2177 OGA Servo Error In Phase
- c. CG 2147 MGA Servo Error In Phase
- d. CG 2112 IG IX Resolver Output Sin
- e. CG 2172 OG IX Resolver Output Sin
- f. CG 2142 MG IX Resolver Output Sin
- g. CG 1040 +120 VDC PIPA Supply DC Level

CAUTION: Before proceeding, insure that the G & N System has been operating in the STANDBY MODE (power configuration as defined in 6.2.3.1) for a minimum period of 2 hours. Exceptions to this requirement are noted in 6.2.5.2.9.

CAUTION NOTE: If the requirements of 6.2.3.1.6 are not met, remove IMU operate power immediately by placing the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

6.2.3.1.5 Perform the following sequence:

- a. Turn on the IMU MN A and MN B circuit breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).
- b. Start Analog Recorders.
- c. Place G/N Power - IMU switch on the LEB Lighting Control Panel to IMU (switch toggle up).

6.2.3.1.6 Immediately begin monitoring the following measurements.

- a. The IMU Operate Power is $+28.8 \pm 3\text{VDC}$ (CG 1500). Verify on CRT.
- b. On the recorders, verify that oscillations are not sustained and that a null is achieved within 10 seconds of power application in 6.2.3.1.5 on the following measurements:

CG 2112, IG IX Resolver Output Sin
CG 2142, MG IX Resolver Output Sin
CG 2172, OG IX Resolver Output Sin

- c. On the CRT, verify the absence of the +120 VDC PIPA supply (CG 1040) for a period of 90 + 10 seconds following power application in 6.2.3.1.5. After approximately 100 seconds, the voltage shall read $+120 \pm 6\text{VDC}$.

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- 6.2.3.1.7 Insure that the following alarm lamps are not lighted on G & N LEB Display Panel.
- a. CMC Warning
 - b. ISS Warning
 - c. PGNS Caution
- 6.2.3.1.8 Verify that the PROGRAM ALARM lamp on the DSKY's does not light with VERB 05 NOUN 31 and RI = 00213 displayed.
- 6.2.3.1.9 The OG, IG, and MG CDU angles shall be 00000 \pm 00150. Verify on CRT.
- 6.2.3.1.10 Verify that the following secondary power supply voltages are not flashing on the CRT display.

Table VI. Secondary Power Supply Voltages

Meas. No.	Signal
1 CG 1040	+120 VDC PIPA SUPPLY
2 CG 1051	+20 VDC PIPA SUPPLY
3 CG 1052	-20 VDC PIPA SUPPLY
4 CG 1070	+4 VDC CDU SUPPLY
5 CG 1100	-28 VDC ELECTRONICS
6 CG 1020	+14 VDC CMC SUPPLY
7 CG 1030	+4 VDC CMC SUPPLY
8 CG 1201	IMU 28 V 800 CPS 1 pct 0 ph
9 CG 1202	IMU 28 V 800 CPS 5 pct ph A
10 CG 1203	IMU 28 V 800 CPS 5 pct ph B
11 CG 1331	3.2KC 28 V SUPPLY
12 CG 1110	2.5 VDC TM BIAS

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- 6.2.3.1.7 Insure that the following alarm lamps are not lighted on G & N LEB Display Panel.
- a. CMC Warning
 - b. ISS Warning
 - c. FGNS Caution
- 6.2.3.1.8 Verify that the PROGRAM ALARM lamp on the DSKY's does not light with VERB 05 NOUN 31 and R1 = 00213 displayed.
- 6.2.3.1.9 The CG, IG, and MG CDU angles shall be 00000 ± 00150. Verify on CRT.
- 6.2.3.1.10 Verify that the following secondary power supply voltages are not flashing on the CRT display.

Table VI. Secondary Power Supply Voltages

Meas. No.	Signal
1 CG 1040	+120 VDC PIPA SUPPLY
2 CG 1051	+20 VDC PIPA SUPPLY
3 CG 1052	-20 VDC PIPA SUPPLY
4 CG 1070	+4 VDC CDU SUPPLY
5 CG 1100	-28 VDC ELECTRONICS
6 CG 1020	+14 VDC CMC SUPPLY
7 CG 1030	+4 VDC CMC SUPPLY
8 CG 1201	IMU 28 V 800 CPS 1 pct 0 ph
9 CG 1202	IMU 28 V 800 CPS 5 pct ph A
10 CG 1203	IMU 28 V 800 CPS 5 pct ph B
11 CG 1331	3.2KC 28 V SUPPLY
12 CG 1110	2.5 VDC TM BIAS

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- 6.2.3.2 Optics Power On
- 6.2.3.2.1 Optics power shall be applied by actuating the G & N OPTICS MN A and OPTICS MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in), and placing G/N Power -OPTICS switch on the LEB Lighting Control Panel to ON.
- 6.2.3.2.2 OPTICS +28 VDC discrete shall be issued (CG 1533). Verify by observing that the OPTICS lamp on Event Module is illuminated. Verify that the +28 VDC OPTX OPERATE BUS (CG 1530) is $\pm 28.8 \pm 3$ VDC. Record the indication on the CRT.
- 6.2.3.2.3 Verify the following secondary power supply voltages on the CRT are not flashing:
- CG 1211 OPTX 28 V 800 CPS 1 pct 0 ph
CG 1212 OPTX 800 CPS 5 pct-90ph
- 6.2.3.3 Enter and verify VERB 40 NOUN 20 into K148. Press the ENTER pushbutton to advance the system to the Zero CDU mode.
- 6.2.3.4 Enter and verify VERB 41, NOUN 20 into K148. Press the ENTER pushbutton to advance the system to Coarse Align under CMC control. The VERB NOUN display on CRT shall flash and indicate 21-22.
- 6.2.3.5 Enter and verify +00000 into K148 three times, pressing the ENTER pushbutton after each entry.

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6.2.3.2 Optics Power On

6.2.3.2.1 Optics power shall be applied by actuating the G & N OPTICS MN A and OPTICS MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in), and placing G/N Power -OPTICS switch on the LEB Lighting Control Panel to ON.

6.2.3.2.2 OPTICS +28 VDC discrete shall be issued (CG 1533). Verify by observing that the OPTICS lamp on Event Module is illuminated. Verify that the +28 VDC OPTX OPERATE BUS (CG 1530) is $+28.8 \pm 3$ VDC. Record the indication on the CRT.

6.2.3.2.3 Verify the following secondary power supply voltages on the CRT are not flashing:

CG 1211 OPTX 28 V 800 CPS 1 pct 0 ph
CG 1212 OPTX 800 CPS 5 pct-90ph

6.2.3.3 Enter and verify VERB 40 NOUN 20 into K148. Press the ENTER pushbutton to advance the system to the Zero CDU mode.

6.2.3.4 Enter and verify VERB 41, NOUN 20 into K148. Press the ENTER pushbutton to advance the system to Coarse Align under CMC control. The VERB NOUN display on CRT shall flash and indicate 21-22.

6.2.3.5 Enter and verify +00000 into K148 three times, pressing the ENTER pushbutton after each entry.

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6.2.4 G & N System Power Supplies Test

6.2.4.1 Proceed with this test if 6.2.3, Operate Power On Test, has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding with this test. Insure that the IMU Operate Power has been on for at least 15 minutes before proceeding with this test.

6.2.4.2 Enter the following sequence into the K-Start. Verb 41 NOUN 20, ENTER; +00000 ENTER; +00000 ENTER, +00000 ENTER.

6.2.4.3 Insure that OPERATE power has been applied for at least 15 minutes. Verify that the discretes listed below have been issued by noting that the event lamps on the specified Event Module are illuminated.

- a. IMU STANDBY POWER (CG 1513)
- b. CMC OPERATE POWER (CG 1523)
- c. OPTX OPERATE POWER (CG 1533)

6.2.4.4 The IRIG and PIPA Pulse Torque DC supply shall demonstrate the following requirements. The DC output voltages shall be as follows. Record the indicated voltages on the CRT.

- a. The 120 volt PIPA Power Supply output voltage shall be 120 ± 6 VDC (CG 1040).
- b. The PIPA +20 VDC Supply output voltage shall be $+20 \pm 1.2$ VDC (CG 1051).
- c. The PIPA -20 VDC output voltage shall be -20 ± 2 VDC (CG 1052).

6.2.4.5 The minus 28 VDC Electronics Power Supply output voltage shall be -27.5 ± 6.0 VDC (CG 1100). Record the indicated voltage displayed on the CRT.

6.2.4.6 Power Supplies

Record the indicated voltage display on the CRT.

- a. The +14 VDC CMC Power output voltage shall be $+14.0 \pm 0.4$ VDC (CG 1020).
- b. The +4 VDC CMC Power Supply output voltage shall be $+4.00 \pm 0.20$ VDC (CG 1030).
- c. The +4 VDC CDU Power Supply output voltage shall be $\pm 4.0 \pm 0.2$ VDC.
- d. The +2.50 TM BIAS Supply output voltage shall be 2.50 ± 0.05 vdc (CG 1110).

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6.2.4 G & N System Power Supplies Test

6.2.4.1 Proceed with this test if 6.2.3, Operate Power On Test, has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding with this test. Insure that the IMU Operate Power has been on for at least 15 minutes before proceeding with this test.

6.2.4.2 Enter the following sequence into the K-Start. Verb 41 NOUN 20, ENTER; +00000 ENTER; +00000 ENTER, +00000 ENTER.

6.2.4.3 Insure that OPERATE power has been applied for at least 15 minutes. Verify that the discretes listed below have been issued by noting that the event lamps on the specified Event Module are illuminated.

- a. IMU STANDBY POWER (CG 1513)
- b. CMC OPERATE POWER (CG 1523)
- c. OPTX OPERATE POWER (CG 1533)

6.2.4.4 The IRIG and PIPA Pulse Torque DC supply shall demonstrate the following requirements. The DC output voltages shall be as follows. Record the indicated voltages on the CRT.

- a. The 120 volt PIPA Power Supply output voltage shall be 120 ± 6 VDC (CG 1040).
- b. The PIPA +20 VDC Supply output voltage shall be $+20 \pm 1.2$ VDC (CG 1051).
- c. The PIPA -20 VDC output voltage shall be -20 ± 2 VDC (CG 1052).

6.2.4.5 The minus 28 VDC Electronics Power Supply output voltage shall be -27.5 ± 6.0 VDC (CG 1100). Record the indicated voltage displayed on the CRT.

6.2.4.6 Power Supplies

Record the indicated voltage display on the CRT.

- a. The +14 VDC CMC Power output voltage shall be $+14.0 \pm 0.4$ VDC (CG 1020).
- b. The +4 VDC CMC Power Supply output voltage shall be $+4.00 \pm 0.20$ VDC (CG 1030).
- c. The +4 VDC CDU Power Supply output voltage shall be $\pm 4.0 \pm 0.2$ VDC.
- d. The +2.50 TM BIAS Supply output voltage shall be 2.50 ± 0.05 vdc (CG 1110).

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6.2.4.7 Twenty-eight volt, 800 CPS Power Supplies - the following values shall be measured with the guidance reference clock synchronizing input pulses. Record the indicated voltage displayed on the CRT.

- a. IMU +28 V, 800 CPS 1 per cent 0 degree voltage shall be 28.0 ± 0.6 VAC (CG 1201).
- b. IMU 28 V, 800 CPS, 5 per cent Ph A -90 degree voltage shall be 28.0 ± 1.4 VAC (CG 1202).
- c. IMU +28 V, 800 CPS 5 per cent Ph B 0 degree voltage shall be 28.0 ± 2.1 VAC (CG 1203).
- d. Optics +28 V, 800 CPS 1 per cent 0 degree voltage shall be 28.0 ± 0.6 VAC (CG 1211).
- e. Optics +28 V, 800 CPS 5 per cent -90 degree voltage shall be 28.0 ± 1.5 VAC (CG 1212).

6.2.4.8 IMU 3200 CPS Supply

The 28 V 3200 CPS Supply feedback output voltage shall be 28.6 ± 0.6 volts RMS (CG 1331). Record the indicated voltage displayed on the CRT.

6.2.4.9 Plus 28 VDC Busses

Record the indicated voltage displayed on the CRT.

- a. The +28 VDC IMU OPERATE (Buss No. 1) output voltage shall be 28.8 (+3, -3) VDC under normal system load (CG 1500).
- b. The +28 VDC IMU STANDBY (Buss No. 2) output voltage shall be 28.8 (+3, -3) VDC under normal system load (CG 1510).
- c. The +28 VDC IMU STANDBY (Buss No. 3) output voltage shall be 28.8 (+3, -3) VDC under normal system load (CG 1520).
- d. The +28 VDC OPTIX OPERATE (Buss No. 4) output voltage shall be 28.8 (+3, -3) VDC under normal system load (CG 1530).

6.2.4.10 Noise

- a. The +14 VDC CMC Power Supply RMS noise shall be less than 0.4 volt (CG 1021).
- b. The +14 VDC CMC Power Supply noise peak shall be less than 0.4 volt pp (CG 1031).

6.2.4.11 IMU 1%/CMC Sync Phase Difference

The Phase difference between the 3.2 kc supply and CMC sync shall be $0^\circ \pm 10^\circ$ (WG 1336). Record the phase difference as indicated on the CRT.

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6.2.4.7 Twenty-eight volt, 800 CPS Power Supplies - the following values shall be measured with the guidance reference clock synchronizing input pulses. Record the indicated voltage displayed on the CRT.

- a. IMU +28 V, 800 CPS 1 per cent 0 degree voltage shall be 28.0 ± 0.6 VAC (CG 1201).
- b. IMU 28 V, 800 CPS, 5 per cent Ph A -90 degree voltage shall be 28.0 ± 1.4 VAC (CG 1202).
- c. IMU +28 V, 800 CPS 5 per cent Ph B 0 degree voltage shall be 28.0 ± 2.1 VAC (CG 1203).
- d. Optics +28 V, 800 CPS 1 per cent 0 degree voltage shall be 28.0 ± 0.6 VAC (CG 1211).
- e. Optics +28 V, 800 CPS 5 per cent -90 degree voltage shall be 28.0 ± 1.5 VAC (CG 1212).

6.2.4.8 IMU 3200 CPS Supply

The 28 V 3200 CPS Supply feedback output voltage shall be 28.6 ± 0.6 volts RMS (CG 1331). Record the indicated voltage displayed on the CRT.

6.2.4.9 Plus 28 VDC Busses

Record the indicated voltage displayed on the CRT.

- a. The +28 VDC IMU OPERATE (Buss No. 1) output voltage shall be 28.8 (+3, -3) VDC under normal system load (CG 1500).
- b. The +28 VDC IMU STANDBY (Buss No. 2) output voltage shall be 28.8 (+3, -3) VDC under normal system load (CG 1510).
- c. The +28 VDC IMU STANDBY (Buss No. 3) output voltage shall be 28.8 (+3, -3) VDC under normal system load (CG 1520).
- d. The +28 VDC OPTX OPERATE (Buss No. 4) output voltage shall be 28.8 (+3, -3) VDC under normal system load (CG 1530).

6.2.4.10 Noise

- a. The +14 VDC CMC Power Supply RMS noise shall be less than 0.4 volt (CG 1021).
- b. The +4 VDC CMC Power Supply noise peak shall be less than 0.4 volt pp (CG 1031).

6.2.4.11 IMU 14/CMC Sync Phase Difference

The Phase difference between the 3.2 kc supply and CMC sync shall be $0^\circ \pm 10^\circ$ (NG 1336). Record the phase difference as indicated on the CRT.

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6.2.4.12 Miscellaneous Checks. - The following miscellaneous signals are required to supply data for system evaluation in event of failure, or for trend analysis of system performance. Record the values of the following signals displayed on the CRT.

- a. CG 4300 CMC Temperature
- b. CG 6020 FIPA Calibration Module Temperature
- c. CG 6021 IMU 800 CPS 5 per cent Temperature

6.2.4.13 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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6.2.4.12 Miscellaneous Checks. - The following miscellaneous signals are required to supply data for system evaluation in event of failure, or for trend analysis of system performance. Record the values of the following signals displayed on the CRT.

- a. CG 4300 CMC Temperature
- b. CG 6020 PIPA Calibration Module Temperature
- c. CG 6021 IMU 800 CPS 5 per cent Temperature

6.2.4.13 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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6.2.5 General Turn Off and Turn On Procedure

NOTE: This procedure shall be utilized any time after performing 6.1.3 Prepower Application Requirements, 6.2.1, Standby Power On Test, and 6.2.3. Operate Power on Test, to turn on or turn off the G&N System. Appropriate portions of this procedure will be referenced in other tests.

6.2.5.1 Turn Off Procedure

CAUTION: This procedure must be performed in the sequence specified. Failure to adhere to this sequence may require calibration of the inertial components.

6.2.5.1.1 Enter the following sequence into the K-148.

- a. VERB 41 NOUN 20, ENTER
- b. +00000 ENTER
- c. +00000 ENTER
- d. +09000 ENTER

Verify that the GIMBAL LOCK indicator on the DSKY's is illuminated.

6.2.5.1.2 Set the following switches on the G&N Indicator Control Panel to the positions designated.

- a. OPTICS MODE to MANUAL
- b. CONTROLLER MODE to DIRECT
- c. CONTROLLER SPEED to MED
- d. TELESCOPE TRUNNION to SLAVE TO SXT
- e. RETICLE BRIGHTNESS to minimum brightness position

6.2.5.1.3 Set the G/N Power - IMU switch on the LEB Lighting Control Panel to OFF and G&N IMU MN A and MN B circuit breakers on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).

6.2.5.1.4 Decrease the LIGHTS - NUMERICS controls on both the Left Hand Circuit Breaker panel and the LEB Lighting Control Panel to the minimum brightness - OFF position.

6.2.5.1.5 Set the IMU HTR MN A and MN B circuit breaker on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).

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6.2.5 General Turn Off and Turn On Procedure

NOTE: This procedure shall be utilized any time after performing 6.1.3 Prepower Application Requirements, 6.2.1, Standby Power On Test, and 6.2.3. Operate Power on Test, to turn on or turn off the G&N System. Appropriate portions of this procedure will be referenced in other tests.

6.2.5.1 Turn Off Procedure

CAUTION: This procedure must be performed in the sequence specified. Failure to adhere to this sequence may require calibration of the inertial components.

6.2.5.1.1 Enter the following sequence into the K-148.

- a. VERB 41 NOUN 20, ENTER
- b. +00000 ENTR
- c. +00000 ENTR
- d. +09000 ENTR

Verify that the GIMBAL LOCK indicator on the DSKY's is illuminated.

6.2.5.1.2 Set the following switches on the G&N Indicator Control Panel to the positions designated.

- a. OPTICS MODE to MANUAL
- b. CONTROLLER MODE to DIRECT
- c. CONTROLLER SPEED to MED
- d. TELESCOPE TRUNNION to SLAVE TO SXT
- e. RETICLE BRIGHTNESS to minimum brightness position

6.2.5.1.3 Set the G/N Power - IMU switch on the LEB Lighting Control Panel to OFF and G&N IMU MN A and MN B circuit breakers on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).

6.2.5.1.4 Decrease the LIGHTS - NUMERICS controls on both the Left Hand Circuit Breaker panel and the LEB Lighting Control Panel to the minimum brightness - OFF position.

6.2.5.1.5 Set the IMU HTR MN A and MN B circuit breaker on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).

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- 6.2.5.1.6 Set the COMPUTER MN A and MN B Circuit breakers on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).
- 6.2.5.1.7 Set the G&N Power AC1-OFF-AC2 Switch on the Right Hand Circuit breaker panel to OFF and the G&N POWER AC1 and AC2 circuit breakers to OFF (breakers pulled out).
- 6.2.5.1.8 Set the G/N POWER - OPTICS switch on the LEB Lighting Control Panel to OFF and G&N OPTICS MN A and MN B breakers on the Right Hand circuit breaker panel to OFF.
- 6.2.5.1.9 Verify that the ICTC is supplying inertial components heater power to the G&N System. This will be indicated by the following on the PTC.
 - a. G&N ON (PTC inhibit) light not illuminated.
 - b. IMU Temp/heater current meter indicates IMU temperature of $130^{\circ} \pm 5^{\circ}\text{F}$.
- 6.2.5.2 Turn ON Procedure
- 6.2.5.2.1 Set or verify the following G&N Indicator Control Panel switches to the position indicated.
 - a. CONDITION LAMPS to ON
 - b. OPTICS MODE to MANUAL
 - c. CONTROLLER COUPLING to DIRECT
 - d. CONTROLLER SPEED to DIRECT
 - e. TELESCOPE TRUNNION to SLAVE to SXT
 - f. RETICLE BRIGHTNESS to minimum brightness position.
- 6.2.5.2.2 Insure that interfacing system EPS and ECS are turned on and operating properly.

CAUTION: The remaining procedure must be followed in sequence specified. Failure to adhere to this sequence may require recalibration of the inertial components.

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- 6.2.5.1.6 Set the COMPUTER MN A and MN B Circuit breakers on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).
- 6.2.5.1.7 Set the G&N Power AC1-OFF-AC2 Switch on the Right Hand Circuit breaker panel to OFF and the G&N POWER AC1 and AC2 circuit breakers to OFF (breakers pulled out).
- 6.2.5.1.8 Set the G/N POWER - OPTICS switch on the LEB Lighting Control Panel to OFF and G&N OPTICS MN A and MN B breakers on the Right Hand circuit breaker panel to OFF.
- 6.2.5.1.9 Verify that the ICTC is supplying inertial components heater power to the G&N System. This will be indicated by the following on the PTC.
 - a. G&N ON (PTC inhibit) light not illuminated.
 - b. IMU Temp/heater current meter indicates IMU temperature of $130^{\circ} \pm 5^{\circ} \text{F}$.
- 6.2.5.2 Turn ON Procedure
- 6.2.5.2.1 Set or verify the following G&N Indicator Control Panel switches to the position indicated.
 - a. CONDITION LAMPS to ON
 - b. OPTICS MODE to MANUAL
 - c. CONTROLLER COUPLING to DIRECT
 - d. CONTROLLER SPEED to DIRECT
 - e. TELESCOPE TRUNNION to SLAVE to SXT
 - f. RETICLE BRIGHTNESS to minimum brightness position.
- 6.2.5.2.2 Insure that interfacing system EPS and ECS are turned on and operating properly.

CAUTION: The remaining procedure must be followed in sequence specified. Failure to adhere to this sequence may require recalibration of the inertial components.

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- 6.2.5.2.3 Energize the G&N IMU HTR, MN A and MN B breakers on the Right Hand Circuit Breaker panel (breakers pushed in).
- 6.2.5.2.4 Energize the G&N COMPUTER MN A and MN B breakers on the Right Hand Circuit Breaker panel (breakers pushed in). If the STBY indicator on the DSKY is illuminated, press the STBY pushbutton for approximately 3 seconds until the STBY indicator extinguishes. Enter VERB 61 into K148 and press the ENTER pushbutton. Insure that the CMC +28 VDC discrete lamp on the Event Module is illuminated (CG 1523). Verify +14 and +4 VDC AGC power supply outputs on CRT display. Voltages shall be $+14 \pm 0.4V$ (CG 1020) and $+4 \pm 0.2$ (CG 1030).
- 6.2.5.2.5 Set the G&N POWER AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in). Set the G&N POWER AC1-OFF-AC2 switch to AC1.
- 6.2.5.2.5.1 Set the G&N DSKY and Display Panel brightness to the minimum a acceptable level by manipulation of LIGHTS - NUMERICS control on both Left Hand circuit breaker panel and LEB light Control panel.
- 6.2.5.2.6 Disregard all alarm indication on the CMC DSKY panels. Enter VERB 36 into K148. Press ENTER pushbutton. Press ERROR RESET pushbuttons on K-Start. All computer alarms except the Gimbal Lock Indicator on the Main Display Console (MDC) and LEB AGC DSKY shall clear. Verify registers R1, R2, and R3 on the DSKY's are cleared.
- 6.2.5.2.7 Clear the CMC erasable memory by entering the following sequence into the K-Start. a. VERB 57, press ENTER
b. 00015, press ENTER
- 6.2.5.2.8 Initiate CMC Self-Test by entering the following into the K-Start:
a. VERB 21 NOUN 27, ENTER
b. 77777, ENTER
c. VERB 15 NOUN 01, ENTER
d. 01366, ENTER
- 6.2.5.2.8.1 Monitor DSKY until R3 (SCOUNT+2) increments twice. If an error is detected, the following will be displayed:
a. VERB 05 NOUN 31
b. R1 = 01102
c. R2 = XXXXX c (SFAIL)
d. R3 = XXXXX c (ERCOUNT)
- 6.2.5.2.8.2 Terminate Self-Test by entering the following into the K-Start.
a. VERB 21 NOUN 27, ENTER
b. 00000, ENTER

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- 6.2.5.2.3 Energize the G&N IMU HTR, MN A and MN B breakers on the Right Hand Circuit Breaker panel (breakers pushed in).
- 6.2.5.2.4 Energize the G&N COMPUTER MN A and MN B breakers on the Right Hand Circuit Breaker panel (breakers pushed in). If the STBY indicator on the DSKY is illuminated, press the STBY pushbutton for approximately 3 seconds until the STBY indicator extinguishes. Enter VERB 61 into K148 and press the ENTER pushbutton. Insure that the CMC +28 VDC discrete lamp on the Event Module is illuminated (CG 1523). Verify +14 and +4 VDC AGC power supply outputs on CRT display. Voltages shall be $+14 \pm 0.4V$ (CG 1020) and $+4 \pm 0.2$ (CG 1030).
- 6.2.5.2.5 Set the G&N POWER AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in). Set the G&N POWER AC1-OFF-AC2 switch to AC1.
- 6.2.5.2.5.1 Set the G&N DSKY and Display Panel brightness to the minimum a acceptable level by manipulation of LIGHTS - NUMERICS control on both Left Hand circuit breaker panel and LEB light Control panel.
- 6.2.5.2.6 Disregard all alarm indication on the CMC DSKY panels. Enter VERB 36 into K148. Press ENTER pushbutton. Press ERROR RESET pushbuttons on K-Start. All computer alarms except the Gimbal Lock Indicator on the Main Display Console (MDC) and LEB AGC DSKY shall clear. Verify registers R1, R2, and R3 on the DSKY's are cleared.
- 6.2.5.2.7 Clear the CMC erasable memory by entering the following sequence into the K-Start. a. VERB 57, press ENTER
b. 00015, press ENTER
- 6.2.5.2.8 Initiate CMC Self-Test by entering the following into the K-Start:
a. VERB 21 NOUN 27, ENTER
b. 77777, ENTER
c. VERB 15 NOUN 01, ENTER
d. 01366, ENTER
- 6.2.5.2.8.1 Monitor DSKY until R3 (SCOUNT+2) increments twice. If an error is detected, the following will be displayed:
a. VERB 05 NOUN 31
b. R1 = 01102
c. R2 = XXXXX c (SFALL)
d. R3 = XXXXX c (ERCOUNT)
- 6.2.5.2.8.2 Terminate Self-Test by entering the following into the K-Start.
a. VERB 21 NOUN 27, ENTER
b. 00000, ENTER

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NOTE: Allow 2 hours to elapse before proceeding to 6.2.5.2.9 with the following exceptions:

- a. If the G&N System has been in the power off state for less than 5 days with the gimbals in the parked position (0°, 0°, 90°) and the system has not been moved, allow 15 minutes to elapse before proceeding.
- b. If the G&N System has been turned off for less than 15 minutes allow 90 seconds to elapse before proceeding.
- c. If the G&N System has been turned off with the gimbals in the unparked position for more than 15 minutes but less than 2 hours allow a warmup time equal to the time off to elapse before proceeding.

CAUTION: If the requirements of 6.2.5.2.10 are not met, remove IMU Operate Power immediately by setting the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

- 6.2.5.2.9 After the required warmup time has elapsed set the G&N IMU MN A and MN B circuit breaker on the Right Hand circuit breaker panel to ON (breaker pushed in), and the G/N POWER - IMU switch on the LEB Lighting Control panel to the ON position (toggle up).

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NOTE: Allow 2 hours to elapse before proceeding to 6.2.5.2.9 with the following exceptions:

- a. If the G&N System has been in the power off state for less than 5 days with the gimbals in the parked position (0°, 0°, 90°) and the system has not been moved, allow 15 minutes to elapse before proceeding.
- b. If the G&N System has been turned off for less than 15 minutes allow 90 seconds to elapse before proceeding.
- c. If the G&N System has been turned off with the gimbals in the unparked position for more than 15 minutes but less than 2 hours allow a warmup time equal to the time off to elapse before proceeding.

CAUTION: If the requirements of 6.2.5.2.10 are not met, remove IMU Operate Power immediately by setting the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

- 6.2.5.2.9 After the required warmup time has elapsed set the G&N IMU MN A and MN B circuit breaker on the Right Hand circuit breaker panel to ON (breaker pushed in), and the G/N POWER - IMU switch on the LEB Lighting Control panel to the ON position (toggle up).

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- 6.2.5.2.10 Immediately begin monitoring the following measurements.
- On the CRT verify that IMU Operate Power is $\pm 28.8 \pm 3$ VDC (CG 1500).
 - On the meter modules verify that oscillations are not sustained and that a null is achieved within 10 seconds of power application on the following measurements:
 - CG 2112 IG 1X Resolver Output Sin
 - CG 2142 MG 1X Resolver Output Sin
 - CG 2172 OG 1X Resolver Output Sin
 - On the CRT verify the absence of the +120 VDC PIPA Supply (CG 1040) for a period of 90 ± 10 seconds following power application. After approximately 100 seconds, the voltage shall read $+120 \pm 6$ VDC.
- 6.2.5.2.11 Verify that the PROGRAM ALARM lamp on the DSKY's does not light with VERB 05 NOUN 31 and R1 = 00213 displayed.
- 6.2.5.2.12 Enter and verify VERB 40, NOUN 20 into K148. Press the ENTER pushbutton.
- 6.2.5.2.13 Enter and verify VERB 41, NOUN 20 into K148. Press the ENTER pushbutton to advance the System to the Coarse Align mode. The VERB-NOUN display on the CRT shall flash and indicate 21-22.
- 6.2.5.2.14 Enter and verify +00000 into K148 three times, pressing the ENTER pushbutton on the K-START after each entry.
- 6.2.5.2.15 Set the G&N OPTICS MN A and MN B circuit breakers on the Right Hand circuit breaker panel to the ON position (breaker pushed in).

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- 6.2.5.2.10 Immediately begin monitoring the following measurements.
- On the CRT verify that IMU Operate Power is $\pm 28.8 \pm 3$ VDC (CG 1500).
 - On the meter modules verify that oscillations are not sustained and that a null is achieved within 10 seconds of power application on the following measurements:

CG 2112	IG 1X Resolver Output Sin
CG 2142	MG 1X Resolver Output Sin
CG 2172	OG 1X Resolver Output Sin
 - On the CRT verify the absence of the +120 VDC PIPA Supply (CG 1040) for a period of 90 ± 10 seconds following power application. After approximately 100 seconds, the voltage shall read $+120 \pm 6$ VDC.
- 6.2.5.2.11 Verify that the PROGRAM ALARM lamp on the DSKY's does not light with VERB 05 NOUN 31 and R1 = 00213 displayed.
- 6.2.5.2.12 Enter and verify VERB 40, NOUN 20 into K148. Press the ENTER pushbutton.
- 6.2.5.2.13 Enter and verify VERB 41, NOUN 20 into K148. Press the ENTER pushbutton to advance the System to the Coarse Align mode. The VERB-NOUN display on the CRT shall flash and indicate 21-22.
- 6.2.5.2.14 Enter and verify +00000 into K148 three times, pressing the ENTER pushbutton on the K-START after each entry.
- 6.2.5.2.15 Set the G&N OPTICS MN A and MN B circuit breakers on the Right Hand circuit breaker panel to the ON position (breaker pushed in).

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6.2.5.2.16 Verify that the CRT indications of the signals in Table VI are not flashing.

Table VI. Secondary Power Supply Voltages

Measurement Number	Signal
1 CG 1040	+120 VDC PIPA SUPPLY
2 CG 1051	+20 VDC PIPA SUPPLY
3 CG 1052	-20 VDC PIPA SUPPLY
4 CG 1070	+4 VDC CDU SUPPLY
5 CG 1100	-28 VDC ELECTRONICS
6 CG 1020	+14 VDC CMC SUPPLY
7 CG 1030	+4 VDC CMC SUPPLY
8 CG 1201	IMU 28V 800 CPS 1 pct 0 ph
9 CG 1202	IMU 28V 800 CPS 5 pct ph A
10 CG 1203	IMU 28V 800 CPS 5 pct ph B
11 CG 1331	3.2 KC 28V SUPPLY
12 CG 1110	2.5 VDC TM BIAS
13 CG 2300	PIPA TEMPERATURE
14 CG 2301	IRIG TEMPERATURE

6.2.5.2.17 Monitor the PIPA Display Scope to insure that each PIPA is moding properly.

6.2.5.2.18 Perform 6.2.6 G&N Operational Test.

6.2.5.3 Master Initialization

6.2.5.3.1 Set/Verify the following Circuit Breakers to ON.

- a. G&N COMPUTER MN A & MN B
- b. G&N POWER AC1 & AC2
- c. G&N IMU HTR MNA & MNB

NOTE: If IMU OPERATE POWER is not ON, refer to paragraph 6.2.5.2.9.

- d. G&N IMU MNA & MNB

6.2.5.3.2 Verify/Record the following measurements:

- a. PIPA Temperature (CG 2300) $130 \pm 1.5^{\circ}\text{F}$.
- b. +28 VDC CMC OPERATE BUS (CG 1520) 28.8 ± 3 VDC.

NOTE: If the GIMBAL LOCK light on the DSKY is lit, proceed to paragraph 6.2.5.3.5.

6.2.5.3.3 Enter VERB 36, ENTER into K148.

6.2.5.3.4 Enter VERB 40 NOUN 20, ENTER into K148.

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6.2.5.2.16 Verify that the CRT indications of the signals in Table VI are not flashing.

Table VI. Secondary Power Supply Voltages

Measurement Number	Signal
1 CG 1040	+120 VDC PIPA SUPPLY
2 CG 1051	+20 VDC PIPA SUPPLY
3 CG 1052	-20 VDC PIPA SUPPLY
4 CG 1070	+4 VDC CDU SUPPLY
5 CG 1100	-28 VDC ELECTRONICS
6 CG 1020	+14 VDC CMC SUPPLY
7 CG 1030	+4 VDC CMC SUPPLY
8 CG 1201	IMU 28V 800 CPS 1 pct 0 ph
9 CG 1202	IMU 28V 800 CPS 5 pct ph A
10 CG 1203	IMU 28V 800 CPS 5 pct ph B
11 CG 1331	3.2 KC 28V SUPPLY
12 CG 1110	2.5 VDC TM BIAS
13 CG 2300	PIPA TEMPERATURE
14 CG 2301	IRIG TEMPERATURE

6.2.5.2.17 Monitor the PIPA Display Scope to insure that each PIPA is moding properly.

6.2.5.2.18 Perform 6.2.6 G&N Operational Test.

6.2.5.3 Master Initialization

6.2.5.3.1 Set/Verify the following Circuit Breakers to ON.

- a. G&N COMPUTER MN A & MN B
- b. G&N POWER AC1 & AC2
- c. G&N IMU HTR MNA & MNB

NOTE: If IMU OPERATE POWER is not ON, refer to paragraph 6.2.5.2.9.

- d. G&N IMU MNA & MNB

6.2.5.3.2 Verify/Record the following measurements:

- a. PIPA Temperature (CG 2300) 130±1.5°F.
- b. +28 VDC CMC OPERATE BUS (CG 1520) 28.8±3 VDC.

NOTE: If the GIMBAL LOCK light on the DSKY is lit, proceed to paragraph 6.2.5.3.5.

6.2.5.3.3 Enter VERB 36, ENTER into K148.

6.2.5.3.4 Enter VERB 40 NOUN 20, ENTER into K148.

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6.2.5.3.5 Enter the following into K148:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

Observe the NO ATT lamp lights and the Inner, Outer, and Middle Gimbal angles are $0 \pm 1.5^\circ$ as indicated by the CDUX, CDUY, and CDUZ displays on the CRT.

6.2.5.3.6 Insure that the following switches are set to the positions indicated.

- a. CONTROLLER COUPLING to DIRECT
- b. OPTICS MODE to MAN
- c. TELESCOPE TRUNNION to SLAVE TO SXT
- d. TRACKER to OFF
- e. CONTROLLER SPEED to LO
- f. CONDITION LAMPS to ON
- g. UP TELEMETRY to ACCEPT

6.2.5.3.7 Press the ERROR RESET pushbutton. Enter the following into K148.

- a. VERB 57, ENTER
- b. 00015, ENTER

6.2.6 G&N Operational Test

6.2.6.1 Initial Conditions

Proceed with this test if the Operate Power On Test of 6.2.3 or the Turn on Procedure of 6.2.5 has been completed and system operation has not be interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding.

6.2.6.1.1 Enter the following into K-148:

- a. VERB 01 NOUN 10, ENTER
 - b. 00003, ENTER
- Record R1 = AAAAA and the time of day

6.2.6.1.2 Enter the following into K-148.

- a. VERB 21 NOUN 02, ENTER
 - b. 01300, ENTER
 - c. AAAAA, ENTER (from 6.2.6.1.1)
 - d. VERB 06 NOUN 02, ENTER
 - e. 01300, ENTER
- Record R1 = BBBB

6.2.6.1.3 Perform the following calculations:

- a. $\frac{R1 (BBBB) \times 5.12}{3600} = \text{CC.C (hours in high order scaler Channel 03)}$

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6.2.5.3.5 Enter the following into K148:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

Observe the NO ATT lamp lights and the Inner, Outer, and Middle Gimbal angles are $0 \pm 1.5^\circ$ as indicated by the CDUX, CDUY, and CDUZ displays on the CRT.

6.2.5.3.6 Insure that the following switches are set to the positions indicated.

- a. CONTROLLER COUPLING to DIRECT
- b. OPTICS MODE to MAN
- c. TELESCOPE TRUNNION to SLAVE TO SXT
- d. TRACKER to OFF
- e. CONTROLLER SPEED to LO
- f. CONDITION LAMPS to ON
- g. UP TELEMETRY to ACCEPT

6.2.5.3.7 Press the ERROR RESET pushbutton. Enter the following into K148.

- a. VERB 57, ENTER
- b. 00015, ENTER

6.2.6 G&N Operational Test

6.2.6.1 Initial Conditions

Proceed with this test if the Operate Power On Test of 6.2.3 or the Turn on Procedure of 6.2.5 has been completed and system operation has not be interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding.

6.2.6.1.1 Enter the following into K-148:

- a. VERB 01 NOUN 10, ENTER
 - b. 00003, ENTER
- Record R1 = AAAAA and the time of day

6.2.6.1.2 Enter the following into K-148.

- a. VERB 21 NOUN 02, ENTER
 - b. 01300, ENTER
 - c. AAAAA, ENTER (from 6.2.6.1.1)
 - d. VERB 06 NOUN 02, ENTER
 - e. 01300, ENTER
- Record R1 = BBBB

6.2.6.1.3 Perform the following calculations:

- a. $\frac{R1 (BBBB) \times 5.12}{3600} = CC.C$ (hours in high order scaler Channel 03)

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b. 23.3 - CC.C = DD.D hours

c. Add DD.D to the time of day recorded in 6.2.6.1.1. This is the time of day at which the high order scalar, channel 03, will overflow.

Do not enter the G&N Operational test within -0.2 hours of the time of day calculated in step 6.2.6.13c. If the test is in process at this time, unacceptable test results will occur.

6.2.6.2 Initiation

6.2.6.2.1 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.6.2.2 Enter 00004 into K148. Press the ENTER pushbutton.

6.2.6.2.3 Verify that the PROGRAM display on the CRT indicates 07.

Enter VERB 34 into K148 and press the ENTER pushbutton.

NOTE: During this portion of the test the G&N System is exercised through its modes. Any failures will be indicated by the PROGRAM ALARM lamp on the DSKY's lighting with VERB 05 NOUN 31 and R1 = 01411 displayed.

6.2.6.2.4 After approximately 12 minutes, VERB 06, NOUN 66 will flash and the value of the gravity vector in cm/sec^2 shall be displayed in R1 and R2 on the CRT. Record these values.

6.2.6.2.5 R1 contains the first five digits of the gravity vector and R2 contains the last five digits. A decimal point shall be between them. The value for the gravity vector shall be $980.00000 \pm 05.00000 \text{ cm/sec}^2$.

6.2.6.2.6 Enter VERB 33 into K148. Press the ENTER pushbutton.

6.2.6.2.7 When VERB 06 NOUN 66 flashes the value of the horizontal earth rate shall be displayed on R1 and R2 on the CRT. Record these values.

6.2.6.2.8 R1 contains the first five digits of earth rate and R2 contains the last five digits. A decimal point shall be placed between them. R1 shall always to 00000. The horizontal earth rate shall be 00000.83000 ± 0.1000 earth rate units.

6.2.6.3 Test Termination

6.2.6.3.1 Enter VERB 36 into K148. Press the ENTER pushbutton.

6.2.6.3.2 Enter VERB 41, NOUN 20 into K148. Press the ENTER pushbutton.

6.2.6.3.3 Enter +00000 into K148 three times. Press the ENTER pushbutton after each entry.

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b. 23.3 - CC.C = DD.D hours

c. Add DD.D to the time of day recorded in 6.2.6.1.1. This is the time of day at which the high order scalar, channel 03, will overflow.

Do not enter the G&N Operational test within -0.2 hours of the time of day calculated in step 6.2.6.13c. If the test is in process at this time, unacceptable test results will occur.

6.2.6.2 Initiation

6.2.6.2.1 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.6.2.2 Enter 00004 into K148. Press the ENTER pushbutton.

6.2.6.2.3 Verify that the PROGRAM display on the CRT indicates 07.

Enter VERB 34 into K148 and press the ENTER pushbutton.

NOTE: During this portion of the test the G&N System is exercised through its modes. Any failures will be indicated by the PROGRAM ALARM lamp on the DSKY's lighting with VERB 05 NOUN 31 and R1 = 01411 displayed.

6.2.6.2.4 After approximately 12 minutes, VERB 06, NOUN 66 will flash and the value of the gravity vector in cm/sec^2 shall be displayed in R1 and R2 on the CRT. Record these values.

6.2.6.2.5 R1 contains the first five digits of the gravity vector and R2 contains the last five digits. A decimal point shall be between them. The value for the gravity vector shall be $980.00000 \pm 05.00000 \text{ cm/sec}^2$.

6.2.6.2.6 Enter VERB 33 into K148. Press the ENTER pushbutton.

6.2.6.2.7 When VERB 06 NOUN 66 flashes the value of the horizontal earth rate shall be displayed on R1 and R2 on the CRT. Record these values.

6.2.6.2.8 R1 contains the first five digits of earth rate and R2 contains the last five digits. A decimal point shall be placed between them. R1 shall always to 00000. The horizontal earth rate shall be 00000.83000 ± 0.1000 earth rate units.

6.2.6.3 Test Termination

6.2.6.3.1 Enter VERB 36 into K148. Press the ENTER pushbutton.

6.2.6.3.2 Enter VERB 41, NOUN 20 into K148. Press the ENTER pushbutton.

6.2.6.3.3 Enter +00000 into K148 three times. Press the ENTER pushbutton after each entry.

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6.2.7 Gimbal Friction Test

6.2.7.1 Proceed with this test if 6.2.5.2 or 6.2.3 has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 before proceeding with this test.

6.2.7.2 Inner Gimbal Friction Test

6.2.7.2.1 Enter the following sequence into the K-Start, pushing the ENTER pushbutton after each entry:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.7.2.2 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

- a. CG 2120 IG TORQUE MOTOR CURRENT
- b. CG 2117 IGA SERVO ERROR IN PHASE
- c. CG 2112 IG 1X RESOLVER OUTPUT SIN
- d. CG 2113 IG 1X RESOLVER OUTPUT COS
- e. CG 2220 IGA CDU FINE ERROR
- f. CG 1201 IMU 28V 0.8 KC 1 pct 0 Deg
- g. CG 2300 PIPA TEMPERATURE
- h. CG 2301 IIRIG TEMPERATURE

6.2.7.2.3 Enter the following into K148.

- a. VERB 01 NOUN 01, ENTER
 - b. 00362, ENTER
- Record R1 = XXXXY

6.2.7.2.4 Enter the following into K148.

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table I and XXXX is that recorded in 6.2.7.2.3.

TABLE I

Y (From 6.2.7.2.3)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.7.2.5 Enter the following sequence into the K-Start, pushing the ENTER pushbutton after each entry (+360 IG torquing)

- a. VERB 24 NOUN 01, ENTER
- b. 00407, ENTER
- c. 40000, ENTER
- d. 40034, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears

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6.2.7 Gimbal Friction Test

6.2.7.1 Proceed with this test if 6.2.5.2 or 6.2.3 has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 before proceeding with this test.

6.2.7.2 Inner Gimbal Friction Test

6.2.7.2.1 Enter the following sequence into the K-Start, pushing the ENTER pushbutton after each entry:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.7.2.2 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

- a. CG 2120 IG TORQUE MOTOR CURRENT
- b. CG 2117 IGA SERVO ERROR IN PHASE
- c. CG 2112 IG 1X RESOLVER OUTPUT SIN
- d. CG 2113 IG 1X RESOLVER OUTPUT COS
- e. CG 2220 IGA CDU FINE ERROR
- f. CG 1201 IMU 28V 0.8 KC 1 pct 0 Deg
- g. CG 2300 PIPA TEMPERATURE
- h. CG 2301 IIRIG TEMPERATURE

6.2.7.2.3 Enter the following into K148.

- a. VERB 01 NOUN 01, ENTER
 - b. 00362, ENTER
- Record R1 = XXXXY

6.2.7.2.4 Enter the following into K148.

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table I and XXXX is that recorded in 6.2.7.2.3.

TABLE I

Y (From 6.2.7.2.3)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.7.2.5 Enter the following sequence into the K-Start, pushing the ENTER pushbutton after each entry (+360 IG torquing)

- a. VERB 24 NOUN 01, ENTER
- b. 00407, ENTER
- c. 40000, ENTER
- d. 40034, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears

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in R3.

- 6.2.7.2.6 Enter the following sequence into K-Start:
- VERB 42, press ENTER
 - VERB 33, press ENTER (verify VERB 33 on CRT)
- 6.2.7.2.7 Start analog recorders.
- 6.2.7.2.8 Observe measurement CG 2112, IG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.
- 6.2.7.2.9 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.
- VERB 40, NOUN 20, press ENTER
 - VERB 41, NOUN 20, press ENTER
 - +00000, press ENTER
 - +00000, press ENTER
 - +00000, press ENTER
- 6.2.7.2.10 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 60 seconds before proceeding.
- 6.2.7.2.11 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (-360° IG torquing):
- VERB 24 NOUN 01 ENTER
 - 00407, ENTER
 - 37777, ENTER
 - 37743, ENTER
- Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.
- 6.2.7.2.12 Enter the following sequence into K-Start:
- VERB 42, press ENTER
 - VERB 33, press ENTER (Verify VERB 33 on CRT).
- 6.2.7.2.13 Start analog recorders.
- 6.2.7.2.14 Observe measurement CG 2112, IG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.
- 6.2.7.2.15 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.
- VERB 40, NOUN 20, press ENTER
 - VERB 41, NOUN 20, press ENTER
 - +00000, press ENTER
 - +00000, press ENTER
 - +00000, press ENTER
- 6.2.7.2.16 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 60 seconds before proceeding.

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in R3.

- 6.2.7.2.6 Enter the following sequence into K-Start:
- VERB 42, press ENTER
 - VERB 33, press ENTER (verify VERB 33 on CRT)
- 6.2.7.2.7 Start analog recorders.
- 6.2.7.2.8 Observe measurement CG 2112, IG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.
- 6.2.7.2.9 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.
- VERB 40, NOUN 20, press ENTER
 - VERB 41, NOUN 20, press ENTER
 - +00000, press ENTER
 - +00000, press ENTER
 - +00000, press ENTER
- 6.2.7.2.10 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 60 seconds before proceeding.
- 6.2.7.2.11 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (-360° IG torquing):
- VERB 24 NOUN 01 ENTER
 - 00407, ENTER
 - 37777, ENTER
 - 37743, ENTER
- Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.
- 6.2.7.2.12 Enter the following sequence into K-Start:
- VERB 42, press ENTER
 - VERB 33, press ENTER (Verify VERB 33 on CRT).
- 6.2.7.2.13 Start analog recorders.
- 6.2.7.2.14 Observe measurement CG 2112, IG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.
- 6.2.7.2.15 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.
- VERB 40, NOUN 20, press ENTER
 - VERB 41, NOUN 20, press ENTER
 - +00000, press ENTER
 - +00000, press ENTER
 - +00000, press ENTER
- 6.2.7.2.16 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 60 seconds before proceeding.

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6.2.7.3 Outer Gimbal Friction Test

6.2.7.3.1 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

- a. CG 2180 OG TORQUE MOTOR CURRENT
- b. CG 2177 OGA SERVO ERROR IN PHASE
- c. CG 2172 OG 1X RESOLVER OUTPUT SIN
- d. CG 2173 OG 1X RESOLVER OUTPUT COS
- e. CG 2280 OGA CDU FINE ERROR
- f. CG 1201 IMU 28 V 0.8 KC 1 PCT 0 DEG RMS
- g. CG 2300 PIPA TEMPERATURE
- h. CG 2301 IRIG TEMPERATURE

6.2.7.3.2 Enter the following sequence into the K-Start. Pushing the ENTER pushbutton after each entry (+360° OG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00405, ENTER
- c. 40000, ENTER
- d. 40034, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.3.3 Enter the following sequence into K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.3.4 Start analog recorders

6.2.7.3.5 Observe measurement CG 2172, OG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.

6.2.7.3.6 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 40, NOUN 20, press ENTER
- b. VERB 41, NOUN 20, press ENTER
- c. +00000, press ENTER
- d. +00000, press ENTER
- e. +00000, press ENTER

6.2.7.3.7 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 60 seconds before proceeding.

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6.2.7.3 Outer Gimbal Friction Test

6.2.7.3.1 Setup the AGE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

- | | | |
|----|---------|---------------------------------|
| a. | CG 2180 | OG TORQUE MOTOR CURRENT |
| b. | CG 2177 | OGA SERVO ERROR IN PHASE |
| c. | CG 2172 | OG 1X RESOLVER OUTPUT SIN |
| d. | CG 2173 | OG 1X RESOLVER OUTPUT COS |
| e. | CG 2280 | OGA CDU FINE ERROR |
| f. | CG 1201 | IMU 28 V 0.8 KC 1 PCT 0 DEG RMS |
| g. | CG 2300 | PIPA TEMPERATURE |
| h. | CG 2301 | IRIG TEMPERATURE |

6.2.7.3.2 Enter the following sequence into the K-Start. Pushing the ENTER pushbutton after each entry (+360° OG torquing):

- VERB 24 NOUN 01, ENTER
- 00405, ENTER
- 40000, ENTER
- 40034, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.3.3 Enter the following sequence into K-Start:

- VERB 42, press ENTER
- VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.3.4 Start analog recorders

6.2.7.3.5 Observe measurement CG 2172, OG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.

6.2.7.3.6 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- VERB 40, NOUN 20, press ENTER
- VERB 41, NOUN 20, press ENTER
- +00000, press ENTER
- +00000, press ENTER
- +00000, press ENTER

6.2.7.3.7 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 60 seconds before proceeding.

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6.2.7.3.8 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (=360° OG torquing):

- a. VERB 24, NOUN 01, ENTER
- b. 00405, ENTER
- c. 37777, ENTER
- d. 37743, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.3.9 Enter the following sequence into K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (verify VERB 33 on CRT).

6.2.7.3.10 Start analog recorders.

6.2.7.3.11 Observe measurement CG 2172, OG 1X resolver output SIN, on the analog recorder. When steady-state condition occurs; with the reading near zero (approximately 12 minutes), stop the recorder.

6.2.7.3.12 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 40, NOUN 20, press ENTER
- b. VERB 41, NOUN 20, press ENTER
- c. +00000, press ENTER
- d. +00000, press ENTER
- e. -06750, press ENTER

6.2.7.3.13 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = -06750, Wait 60 seconds before proceeding.

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6.2.7.3.8 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (=360° OG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00405, ENTER
- c. 37777, ENTER
- d. 37743, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.3.9 Enter the following sequence into K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (verify VERB 33 on CRT).

6.2.7.3.10 Start analog recorders.

6.2.7.3.11 Observe measurement CG 2172, OG 1X resolver output SIN, on the analog recorder. When steady-state condition occurs; with the reading near zero (approximately 12 minutes), stop the recorder.

6.2.7.3.12 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 40, NOUN 20, press ENTER
- b. VERB 41, NOUN 20, press ENTER
- c. +00000, press ENTER
- d. +00000, press ENTER
- e. -06750, press ENTER

6.2.7.3.13 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = -06750, Wait 60 seconds before proceeding.

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6.2.7.4 Middle Gimbal Friction Test

6.2.7.4.1 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

- a. CG 2150 MG TORQUE MOTOR CURRENT
- b. CG 2147 MGA SERVO ERROR IN PHASE
- c. CG 2142 MG LX RESOLVER OUTPUT SIN
- d. CG 2143 MG LX RESOLVER OUTPUT COS
- e. CG 2250 MGA CDU FINE ERROR
- f. CG 2101 IMU 28V, 0.8 KC 1 PCT 0 DEG RMS
- g. CG 2300 PIPA TEMPERATURE
- h. CG 2301 IRIG TEMPERATURE

6.2.7.4.2 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (+135° MG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00411, ENTER
- c. 63777, ENTER
- d. 77777, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.4.3 Enter the following sequence in the K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.4.4 Start the analog recorder.

6.2.7.4.5 Observe measurement CG 2142, MG LX Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 5 minutes), stop the recorders.

6.2.7.4.6 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 40 NOUN 01, ENTER
- b. VERB 41 NOUN 20, press ENTER
- c. +00000, press ENTER
- d. +00000, press ENTER
- e. +06750, press ENTER

6.2.7.4.8 Enter the following sequence into the K-Start. Push ENTER pushbutton after each entry (-135° MG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00411, ENTER
- c. 14000, ENTER
- d. 00000, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

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6.2.7.4 Middle Gimbal Friction Test

6.2.7.4.1 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

- a. CG 2150 MG TORQUE MOTOR CURRENT
- b. CG 2147 MGA SERVO ERROR IN PHASE
- c. CG 2142 MG 1X RESOLVER OUTPUT SIN
- d. CG 2143 MG 1X RESOLVER OUTPUT COS
- e. CG 2250 MGA CDU FINE ERROR
- f. CG 2101 IMU 28V, 0.8 KC 1 PCT 0 DEG RMS
- g. CG 2300 PIPA TEMPERATURE
- h. CG 2301 IRIG TEMPERATURE

6.2.7.4.2 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (+135° MG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00411, ENTER
- c. 63777, ENTER
- d. 77777, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.4.3 Enter the following sequence in the K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.4.4 Start the analog recorder.

6.2.7.4.5 Observe measurement CG 2142, MG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 5 minutes), stop the recorders.

6.2.7.4.6 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 40 NOUN 01, ENTER
- b. VERB 41 NOUN 20, press ENTER
- c. +00000, press ENTER
- d. +00000, press ENTER
- e. +06750, press ENTER

6.2.7.4.8 Enter the following sequence into the K-Start. Push ENTER pushbutton after each entry (-135° MG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00411, ENTER
- c. 14000, ENTER
- d. 00000, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

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6.2.7.4.9 Enter the following sequence in the K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.4.10 Start analog recorders.

6.2.7.4.11 Observe measurement CG 2143, MG LX Resolver output SIN, on the analog recorder. When the steady-state condition occurs, with the reading near zero (approximately 5 minutes), stop the recorders.

6.2.7.4.12 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 36, ENTER
- b. VERB 40 NOUN 20, press ENTER
- c. VERB 41 NOUN 20, press ENTER
- d. +00000, press ENTER
- e. +00000, press ENTER
- f. +00000, press ENTER

6.2.7.5 Examine the traces of the recorded measurements for all six phases of this test to detect any sharp discontinuities. Disregard transients of 0.5 second duration or less on the Gimbal Torque motor current traces, and those less than 0.2 second on the CDU fine error measurement traces. The Gimbal Torque motor currents shall not exceed 0.125 ampere.

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6.2.7.4.9 Enter the following sequence in the K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.4.10 Start analog recorders.

6.2.7.4.11 Observe measurement CG 2143, MG LX Resolver output SIN, on the analog recorder. When the steady-state condition occurs, with the reading near zero (approximately 5 minutes), stop the recorders.

6.2.7.4.12 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 36, ENTER
- b. VERB 40 NOUN 20, press ENTER
- c. VERB 41 NOUN 20, press ENTER
- d. +00000, press ENTER
- e. +00000, press ENTER
- f. +00000, press ENTER

6.2.7.5 Examine the traces of the recorded measurements for all six phases of this test to detect any sharp discontinuities. Disregard transients of 0.5 second duration or less on the Gimbal Torque motor current traces, and those less than 0.2 second on the CDU fine error measurement traces. The Gimbal Torque motor currents shall not exceed 0.125 ampere.

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- 6.2.8 G&N Panel Brightness and Lamp Test
- 6.2.8.1 Proceed with this test if 6.2.5.2 or 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 before proceeding with this test.
- 6.2.8.2 Rotate the RETICLE BRIGHTNESS thumbwheel on the Control Indicator Panel and verify the capability to control the illumination of the following lamps:
- a. SCT reticles
 - b. SET reticles
 - c. Telescope Panel Angle Counters
- 6.2.8.3 Turn on LIGHTS-INTEGRAL control on Left Hand Circuit Breaker panel and LEB Lighting Control Panel.
- 6.2.8.4 Adjust the brightness controls on the LEB Lighting Control Panel and Left Hand Circuit Breaker Panel from minimum brightness to maximum brightness. Verify the operation of the G&N Indicator Control Panel lamps.
- 6.2.8.4.1 Re-adjust brightness controls for minimum acceptable lighting. Turn off LIGHTS-INTEGRAL control on Left Hand Circuit Breaker panel and LEB Lighting Control Panel.
- 6.2.8.5 Push and hold the CONDITION LAMPS switch on the G&N Indicator Control Panel to TEST. Verify the illumination of the following lamps:
- a. STAR ACQ
 - b. MASTER ALARM Lamp
- 6.2.8.6 Set the CONDITION LAMPS switch to ON. Lamps a and b in 6.2.8.5. . . shall extinguish.

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- 6.2.8 G&N Panel Brightness and Lamp Test
- 6.2.8.1 Proceed with this test if 6.2.5.2 or 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 before proceeding with this test.
- 6.2.8.2 Rotate the RETICLE BRIGHTNESS thumbwheel on the Control Indicator Panel and verify the capability to control the illumination of the following lamps:
- a. SCT reticles
 - b. SXT reticles
 - c. Telescope Panel Angle Counters
- 6.2.8.3 Turn on LIGHTS-INTEGRAL control on Left Hand Circuit Breaker panel and LEB Lighting Control Panel.
- 6.2.8.4 Adjust the brightness controls on the LEB Lighting Control Panel and Left Hand Circuit Breaker Panel from minimum brightness to maximum brightness. Verify the operation of the G&N Indicator Control Panel lamps.
- 6.2.8.4.1 Re-adjust brightness controls for minimum acceptable lighting. Turn off LIGHTS-INTEGRAL control on Left Hand Circuit Breaker panel and LEB Lighting Control Panel.
- 6.2.8.5 Push and hold the CONDITION LAMPS switch on the G&N Indicator Control Panel to TEST. Verify the illumination of the following lamps:
- a. STAR ACQ
 - b. MASTER ALARM lamp
- 6.2.8.6 Set the CONDITION LAMPS switch to ON. Lamps a and b in 6.2.8.5. shall extinguish.

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- 6.2.9 **Semi-Automatic Moding Check**
- 6.2.9.1 **Perform Master Initialization 6.2.5.3 before proceeding.**
- 6.2.9.1.1 **Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG1530) is $+28.0 \pm 3.0$ VDC. Record the indication on the CRT. Verify that OPTX 28V 800 cps 1% oph (CG1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.**
- 6.2.9.1.2 **Enter VERB 67 into K148. Press the ENTER pushbutton.**
- 6.2.9.1.3 **Enter 00010 into K148. Press the ENTER pushbutton.**
- 6.2.9.1.4 **Observe VERB 06 NOUN 01 flashes on the CRT and the PROGRAM display indicates 07.**
- 6.2.9.2 **Enter VERB 33 and press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.**
- a. VERB 06 NOUN 02 flashing
 - b. $R1 = +00000 \pm 00007$
 - c. $R2 = +00000 \pm 00007$
 - d. $R3 = +00000 \pm 00007$
 - e. IG angle = 000 ± 1 deg.
 - f. MG angle = 000 ± 1 deg.
 - g. OG angle = 000 ± 1 deg.
- 6.2.9.3 **Enter VERB 33 and press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.**
- a. VERB 06 NOUN 03 flashing
 - b. $R1 = +04500 \pm 00007$
 - c. $R2 = +04500 \pm 00007$
 - d. $R3 = +04500 \pm 00007$
 - e. IG angle = 045 ± 1 deg.
 - f. MG angle = 045 ± 1 deg.
 - g. OG angle = 045 ± 1 deg.
- 6.2.9.4 **Enter VERB 33 and press the ENTER pushbutton. After approximately 100 seconds the following data shall be displayed on the CRT.**
- a. VERB 05 NOUN 30 flashing
 - b. $R1 = 00000 \pm 00003$
 - c. $R2 = 00000 \pm 00003$
 - d. $R3 = 00000 \pm 00003$

NOTE: Negative numbers will be displayed in octal complement form, i.e., -00001 = 77776.

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- 6.2.9 Semi-Automatic Moding Check Initialization. If system open, the
6.2.9.1 Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.9.1.1 Set the G/N POWER-OPTICS switch on the LEB Lighting Control
Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS
(CG1530) is +28.0±3.0 VDC. Record the indication on the CRT. Verify
that OPTX 28V 800 cps 1% oph (CG1211) and OPTX 28V 800 cps 5%-90 ph
(CG 1212) are not flashing on the CRT.
- 6.2.9.1.2 Enter VERB 57 into K148. Press the ENTER pushbutton.
- 6.2.9.1.3 Enter 00010 into K148. Press the ENTER pushbutton.
- 6.2.9.1.4 Observe VERB 06 NOUN 01 flashes on the CRT and the PROGRAM display
indicates 07.
- 6.2.9.2 Enter VERB 33 and press the ENTER pushbutton. After approximately
30 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 02 flashing
 - b. R1 = +00000 ± 00007
 - c. R2 = +00000 ± 00007
 - d. R3 = +00000 ± 00007
 - e. IG angle = 000 ± 1 deg.
 - f. MG angle = 000 ± 1 deg.
 - g. OG angle = 000 ± 1 deg.
- 6.2.9.3 Enter VERB 33 and press the ENTER pushbutton. After approximately
30 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 03 flashing
 - b. R1 = +04500 ± 00007
 - c. R2 = +04500 ± 00007
 - d. R3 = +04500 ± 00007
 - e. IG angle = 045 ± 1 deg.
 - f. MG angle = 045 ± 1 deg.
 - g. OG angle = 045 ± 1 deg.
- 6.2.9.4 Enter VERB 33 and press the ENTER pushbutton. After approximately
100 seconds the following data shall be displayed on the CRT.
- a. VERB 05 NOUN 30 flashing
 - b. R1 = 00000 ± 00003
 - c. R2 = 00000 ± 00003
 - d. R3 = 00000 ± 00003

NOTE: Negative numbers will be displayed in octal complement form,
i.e., -00001 = 77776.

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- 6.2.9.5 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 05 flashing
 - b. $R1 = +07100 \pm 00007$
 - c. $R2 = +07100 \pm 00007$
 - d. $R3 = +07100 \pm 00007$
 - e. IG angle = 071 ± 1 deg.
 - f. MG angle = 071 ± 1 deg.
 - g. OG angle = 071 ± 1 deg.
- The GIMBAL LOCK lamps on the DSKY's shall light.
- 6.2.9.6 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 06 flashing
 - b. $R1 = +09000 \pm 00007$
 - c. $R2 = +09000 \pm 00007$
 - d. $R3 = +09000 \pm 00007$
 - e. IG angle = 090 ± 1 deg.
 - f. MG angle = 090 ± 1 deg.
 - g. OG angle = 090 ± 1 deg.
- 6.2.9.7 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 07
 - b. $R1 = +13500 \pm 00007$
 - c. $R2 = +13500 \pm 00007$
 - d. $R3 = +13500 \pm 00007$
 - e. IG angle = 135 ± 1 deg.
 - f. MG angle = 135 ± 1 deg.
 - g. OG angle = 135 ± 1 deg.
- 6.2.9.8 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds VERB 06 NOUN 10 shall flash. The GIMBAL LOCK lamp shall extinguish on the DSKY's.
- 6.2.9.9 Enter VERB 33 and press the ENTER pushbutton. After approximately 100 seconds the following data shall be displayed on the CRT.
- a. VERB 05 NOUN 30 flashing
 - b. $R1 = 00000 \pm 00003$
 - c. $R2 = 00000 \pm 00003$
 - d. $R3 = 00000 \pm 00003$

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6.2.9.5 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 05 flashing
- b. R1 = +07100 ± 00007
- c. R2 = +07100 ± 00007
- d. R3 = +07100 ± 00007
- e. IG angle = 071 ± 1 deg.
- f. MG angle = 071 ± 1 deg.
- g. OG angle = 071 ± 1 deg.

The GIMBAL LOCK lamps on the DSKY's shall light.

6.2.9.6 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 06 flashing
- b. R1 = +09000 ± 00007
- c. R2 = +09000 ± 00007
- d. R3 = +09000 ± 00007
- e. IG angle = 090 ± 1 deg.
- f. MG angle = 090 ± 1 deg.
- g. OG angle = 090 ± 1 deg.

6.2.9.7 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 07
- b. R1 = +13500 ± 00007
- c. R2 = +13500 ± 00007
- d. R3 = +13500 ± 00007
- e. IG angle = 135 ± 1 deg.
- f. MG angle = 135 ± 1 deg.
- g. OG angle = 135 ± 1 deg.

6.2.9.8 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds VERB 06 NOUN 10 shall flash. The GIMBAL LOCK lamp shall extinguish on the DSKY's.

6.2.9.9 Enter VERB 33 and press the ENTER pushbutton. After approximately 100 seconds the following data shall be displayed on the CRT.

- a. VERB 05 NOUN 30 flashing
- b. R1 = 00000 ± 00003
- c. R2 = 00000 ± 00003
- d. R3 = 00000 ± 00003

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6.2.9.10 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 12 flashing
- b. $R1 = +22500 \pm 00007$
- c. $R2 = +22500 \pm 00007$
- d. $R3 = +22500 \pm 00007$
- e. IG angle = 225 ± 1 deg.
- f. MG angle = 225 ± 1 deg.
- g. OG angle = 225 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY's shall light.

6.2.9.11 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 13 flashing
- b. $R1 = +22500 \pm 00007$
- c. $R2 = +22500 \pm 00007$
- d. $R3 = +31500 \pm 00007$
- e. IG angle = 225 ± 1 deg.
- f. OG angle = 225 ± 1 deg.
- g. MG angle = 315 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY shall extinguish.

6.2.9.12 Enter VERB 33 and press the ENTER pushbutton. After approximately 100 seconds the following data shall be displayed on the CRT.

- a. VERB 05 NOUN 30 flashing
- b. $R1 = 00000 \pm 00003$
- c. $R2 = 00000 \pm 00003$
- d. $R3 = 00000 \pm 00003$

6.2.9.13 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 15 flashing
- b. $R1 = +31500 \pm 00007$
- c. $R2 = +31500 \pm 00007$
- d. $R3 = +31500 \pm 00007$
- e. IG angle = 315 ± 1 deg.
- f. MG angle = 315 ± 1 deg.
- g. OG angle = 315 ± 1 deg.

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6.2.9.10 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 12 flashing
- b. $R1 = +22500 \pm 00007$
- c. $R2 = +22500 \pm 00007$
- d. $R3 = +22500 \pm 00007$
- e. IG angle = 225 ± 1 deg.
- f. MG angle = 225 ± 1 deg.
- g. OG angle = 225 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY's shall light.

6.2.9.11 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 13 flashing
- b. $R1 = +22500 \pm 00007$
- c. $R2 = +22500 \pm 00007$
- d. $R3 = +31500 \pm 00007$
- e. IG angle = 225 ± 1 deg.
- f. OG angle = 225 ± 1 deg.
- g. MG angle = 315 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY shall extinguish.

6.2.9.12 Enter VERB 33 and press the ENTER pushbutton. After approximately 100 seconds the following data shall be displayed on the CRT.

- a. VERB 05 NOUN 30 flashing
- b. $R1 = 00000 \pm 00003$
- c. $R2 = 00000 \pm 00003$
- d. $R3 = 00000 \pm 00003$

6.2.9.13 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 15 flashing
- b. $R1 = +31500 \pm 00007$
- c. $R2 = +31500 \pm 00007$
- d. $R3 = +31500 \pm 00007$
- e. IG angle = 315 ± 1 deg.
- f. MG angle = 315 ± 1 deg.
- g. OG angle = 315 ± 1 deg.

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6.2.9.14 Enter VERB 33 and press the ENTER pushbutton. After approximately 100 seconds the following data shall be displayed on the CRT.

- a. VERB 05 NOUN 30 flashing
- b. R1 = 00000 ± 00003
- c. R2 = 00000 ± 00003
- d. R3 = 00000 ± 00003

6.2.9.15 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 17 flashing
- b. R1 = +28900 ± 00007
- c. R2 = +28900 ± 00007
- d. R3 = +28900 ± 00007
- e. IG angle = 315 ± 1 deg.
- f. OG angle = 315 ± 1 deg.
- g. MG angle = 289 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY's shall light.

6.2.9.16 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data will be displayed on the CRT.

- a. VERB 06 NOUN 20 flashing
- b. R1 = +00000 ± 00007
- c. R2 = +00000 ± 00007
- d. R3 = +00000 ± 00007
- e. IG angle = 000 ± 1 deg.
- f. MG angle = 000 ± 1 deg.
- g. OG angle = 000 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY's shall extinguish.

6.2.9.17 Enter VERB 33 and press the ENTER pushbutton. After approximately 15 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 66 flashing
- b. R1 = 000xx
- c. R2 = xxxxx

The GIMBAL LOCK lamp on the DSKY's shall light.

Record R1 and R2 as the Middle Gimbal CDU drive rate.

MG rate = $\frac{R1}{R2}$ °/sec. The Middle Gimbal CDU drive rate shall be $14 \pm 2^\circ/\text{sec}$.

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6.2.9.14 Enter VERB 33 and press the ENTER pushbutton. After approximately 100 seconds the following data shall be displayed on the CRT.

- a. VERB 05 NOUN 30 flashing
- b. R1 = 00000 ± 00003
- c. R2 = 60000 ± 00003
- d. R3 = 00000 ± 00003

6.2.9.15 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 17 flashing
- b. R1 = +28900 ± 00007
- c. R2 = +28900 ± 00007
- d. R3 = +28900 ± 00007
- e. IG angle = 315 ± 1 deg.
- f. OG angle = 315 ± 1 deg.
- g. MG angle = 289 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY's shall light.

6.2.9.16 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data will be displayed on the CRT.

- a. VERB 06 NOUN 20 flashing
- b. R1 = +00000 ± 00007
- c. R2 = +00000 ± 00007
- d. R3 = +00000 ± 00007
- e. IG angle = 000 ± 1 deg.
- f. MG angle = 000 ± 1 deg.
- g. OG angle = 000 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY's shall extinguish.

6.2.9.17 Enter VERB 33 and press the ENTER pushbutton. After approximately 15 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 66 flashing
- b. R1 = 000xx
- c. R2 = xxxxx

The GIMBAL LOCK lamp on the DSKY's shall light.

Record R1 and R2 as the Middle Gimbal CDU drive rate.
MG rate = $\frac{R1}{R2}$ °/sec. The Middle Gimbal CDU drive rate shall be $14 \pm 2^\circ/\text{sec}$.

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6.2.9.18 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 66 flashing
b. R1 = 000xx
c. R2 = xxxxx

The GIMBAL LOCK lamp on the DSKY's shall extinguish.

Record R1 and R2 as the Inner Gimbal CDU drive rate.
IG rate = $\frac{R1}{R2} \cdot \frac{R2}{0}$ /sec. The Inner Gimbal CDU drive
rate shall be $14 + 2^0$ /sec.

6.2.9.19 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

- VERB 06 NOUN 66 flashing
- R1 = 000xx
- R2 = xxxxx

Record R1 and R2 as the Outer Gimbal CDU drive rate.
OG rate = $\frac{R1}{14} \cdot \frac{R2}{20}$. The Outer Gimbal CDU drive rate shall be 14 + 20/sec.

6.2.9.20 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds VERB 21 NOUN 22 shall flash on the CRT. Enter +00100 into K148 three times. Press the ENTER pushbutton after each entry. After approximately 100 seconds VERB 01 NOUN 10 flashing shall be displayed on the CRT. Press the ENTER pushbutton.

Enter 00030 into K148. Press the ENTER pushbutton. Verify R1 = 3300.

The ISS WARNING Lamp on the Indicator Control Panel shall light.
The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be ON.

6.2.9.21 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds VERB 21 NOUN 22 shall flash on the CRT. Enter +03375 into K148 three times. Press the ENTER pushbutton after each entry. After approximately 100 seconds VERB 01 NOUN 10 flashing shall be displayed on the CRT. Press the ENTER pushbutton.

Enter 00030 into K148. Press the ~~ENTER~~ pushbutton.
Verify R1 = 3300k.

The ISS WARNING lamp on the Indicator Control Panel shall light.
The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be ON.

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6.2.9.18 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 66 flashing
- b. R1 = 000xx
- c. R2 = xxxxx

The GIMBAL LOCK lamp on the DSKY's shall extinguish.

Record R1 and R2 as the Inner Gimbal CDU drive rate.

IG rate = $\frac{R1}{14} \cdot \frac{R2}{20}$ /sec. The Inner Gimbal CDU drive rate shall be $14 \pm 2^\circ$ /sec.

6.2.9.19 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 66 flashing
- b. R1 = 000xx
- c. R2 = xxxxx

Record R1 and R2 as the Outer Gimbal CDU drive rate.

OG rate = $\frac{R1}{14} \cdot \frac{R2}{20}$. The Outer Gimbal CDU drive rate shall be $14 \pm 2^\circ$ /sec.

6.2.9.20 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds VERB 21 NOUN 22 shall flash on the CRT. Enter +00100 into K148 three times. Press the ENTER pushbutton after each entry. After approximately 100 seconds VERB 01 NOUN 10 flashing shall be displayed on the CRT. Press the ENTER pushbutton.

Enter 00030 into K148. Press the ENTER pushbutton. Verify R1 = 33xxx.

The ISS WARNING Lamp on the Indicator Control Panel shall light.

The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be ON.

6.2.9.21 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds VERB 21 NOUN 22 shall flash on the CRT. Enter +03375 into K148 three times. Press the ENTER pushbutton after each entry. After approximately 100 seconds VERB 01 NOUN 10 flashing shall be displayed on the CRT. Press the ENTER pushbutton.

Enter 00030 into K148. Press the ENTER pushbutton.

Verify R1 = 33xxx.

The ISS WARNING lamp on the Indicator Control Panel shall light.

The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be ON.

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- 6.2.9.22 Enter VERB 33 into K148. Press the ENTER pushbutton. VERB 06 NOUN 55 shall flash on the CRT. The ISS WARNING lamp on the Control Indicator Panel shall extinguish. The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be OFF.
- 6.2.9.23 Set the OPTICS MODE switch on the Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to CMC.
- 6.2.9.24 Enter VERB 33 into K-148 and press the ENTER pushbutton. After approximately 25 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 66 flashing
 - b. R1 = 000xx
 - c. R2 = xxxxx
- Record R1 and R2 as the Shaft Optics CDU drive rate.
 $\text{Shaft rate} = \frac{R1}{R2}$. The Shaft Optics CDU drive rate shall be 7.32 ± 1.82 /sec.
- 6.2.9.25 Enter VERB 33 into K148. Press the ENTER pushbutton. In about 15 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 66
 - b. R1 = 0000x
 - c. R2 = xxxxx
- Record R1 and R2 as the Trunnion Optics CDU drive rate. Trunnion rate = $\frac{R1}{R2}$. The Trunnion Optics CDU drive rate shall be 1.83 ± 0.50 /sec.
- 6.2.9.26 Terminate the Semi-Automatic Moding Check by entering VERB 34 into K148. Press the ENTER pushbutton. Set the G&N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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- 6.2.9.22 Enter VERB 33 into K148. Press the ENTER pushbutton. VERB 06 NOUN 55 shall flash on the CRT. The ISS WARNING lamp on the Control Indicator Panel shall extinguish. The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be OFF.
- 6.2.9.23 Set the OPTICS MODE switch on the Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to CMD.
- 6.2.9.24 Enter VERB 33 into K-148 and press the ENTER pushbutton. After approximately 25 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 66 flashing
 - b. R1 = 0000x
 - c. R2 = xxxxx
- Record R1 and R2 as the Shaft Optics CDU drive rate.
 $\text{Shaft rate} = \frac{R1}{R2} \cdot \frac{R2}{R2}$. The Shaft Optics CDU drive rate shall be $7.32 \pm 1.82^\circ/\text{sec}$.
- 6.2.9.25 Enter VERB 33 into K148. Press the ENTER pushbutton. In about 15 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 66
 - b. R1 = 0000x
 - c. R2 = xxxxx
- Record R1 and R2 as the Trunnion Optics CDU drive rate. Trunnion rate = $\frac{R1}{R2} \cdot \frac{R2}{R2}$. The Trunnion Optics CDU drive rate shall be $1.83 \pm 0.50^\circ/\text{sec}$.
- 6.2.9.26 Terminate the Semi-Automatic Moding Check by entering VERB 34 into K148. Press the ENTER pushbutton. Set the G&N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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6.2.10 Zero Optics Test

NOTE: Proceed with this test if 6.2.4 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.2.2 Turn On procedure before proceeding.

- 6.2.10.1 Set the G/N POWER - OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $+28.0 \pm 3.0$ VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 0 ph (CG 1212) are not flashing on the CRT.
- 6.2.10.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.
- VERB 41, NOUN 20, ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER
- 6.2.10.3 Insure that the following switches on the G&N Indicator Control Panel are set as follows:
- TELESCOPE TRUNNION to SLAVE TO SXT
 - CONTROLLER COUPLING to DIRECT
 - CONTROLLER SPEED to HI
- 6.2.10.4 Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K148. Press the ENTER pushbutton.
- 6.2.10.5 Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following on R1 and R2 of the DSKY.
- $R1 = +000.00 \pm 000.03$ (Shaft Angle)
 - $R2 = +00.000 \pm 00.006$ (Trunnion LOS Angle)
- Return the OPTICS MODE switch to MAN.
- 6.2.10.6 Set up the Analog Recorder to monitor the following measurements. Use a chart speed of 10 mm/sec.
- CG 3140 SXT Shaft Tach Output
 - CG 3145 SXT Shaft Motor Control Winding
 - CG 3150 SXT Trunnion Tach Output
 - CG 3155 SXT Trunnion Motor Control Winding
 - CG 3160 SCT Shaft Tach Output
 - CG 3170 SCT Trunnion Tach Output

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6.2.10 Zero Optics Test

NOTE: Proceed with this test if 6.2.4 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.2.2 Turn On procedure before proceeding.

6.2.10.1 Set the G/N POWER - OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $+28.0 \pm 3.0$ VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.10.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.

- a. VERB 41, NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.10.3 Insure that the following switches on the G&N Indicator Control Panel are set as follows:

- a. TELESCOPE TRUNNION to SLAVE TO SXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to HI

6.2.10.4 Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K148. Press the ENTER pushbutton.

6.2.10.5 Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following on R1 and R2 of the DSKY.

- a. R1 = $+000.00 \pm 000.03$ (Shaft Angle)
- b. R2 = $+00.000 \pm 00.006$ (Trunnion LOS Angle)

Return the OPTICS MODE switch to MAN.

6.2.10.6 Set up the Analog Recorder to monitor the following measurements. Use a chart speed of 10 mm/sec.

- a. CG 3140 SXT Shaft Tach Output
- b. CG 3145 SXT Shaft Motor Control Winding
- c. CG 3150 SXT Trunnion Tach Output
- d. CG 3155 SXT Trunnion Motor Control Winding
- e. CG 3160 SCT Shaft Tach Output
- f. CG 3170 SCT Trunnion Tach Output

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- 6.2.10.7 Push the Optics Hand Controller to the right, driving the SXT Shaft until R1 on the DSKY indicates $+180 \pm 1^\circ$. Push the Optics Hand Controller up, driving the SXT Trunnion until R2 on the DSKY indicates $+75 \pm 1^\circ$.
- 6.2.10.8 Start the Analog Recorders and set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.
- 6.2.10.9 Monitor the Analog Recorders until all signals return to null. Stop the Analog Recorders. The elapsed time between the initial and final SXT Tach output null shall be less than 15 seconds.
- 6.2.10.10 Record R1 and R2 on the CRT. The data displayed shall be as follows:
 - a. R1 = 000.00 ± 000.03
 - b. R2 = 00.000 ± 00.006Enter VERB 34 and press the ENTER pushbutton.
- 6.2.10.11 Record the Telescope Panel Angle Counter indications. The Shaft Angle shall be 0.0 ± 0.11 degrees. The Trunnion Angle shall be 0.0 ± 0.22 degrees.
- 6.2.10.12 Set the OPTICS MODE switch on the G&N Indicator Control Panel to MAN.

NOTE: If optics testing will not be continued, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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- 6.2.10.7 Push the Optics Hand Controller to the right, driving the SXT Shaft until R1 on the DSKY indicates $\pm 180 \pm 1^\circ$. Push the Optics Hand Controller up, driving the SXT Trunnion until R2 on the DSKY indicates $\pm 75 \pm 1^\circ$.
- 6.2.10.8 Start the Analog Recorders and set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.
- 6.2.10.9 Monitor the Analog Recorders until all signals return to null. Stop the Analog Recorders. The elapsed time between the initial and final SXT Tach output null shall be less than 15 seconds.
- 6.2.10.10 Record R1 and R2 on the CRT. The data displayed shall be as follows:
- a. R1 = 000.00 ± 000.03
 - b. R2 = 00.000 ± 00.006
- Enter VERB 34 and press the ENTER pushbutton.
- 6.2.10.11 Record the Telescope Panel Angle Counter indications. The Shaft Angle shall be 0.0 ± 0.11 degrees. The Trunnion Angle shall be 0.0 ± 0.22 degrees.
- 6.2.10.12 Set the OPTICS MODE switch on the G&N Indicator Control Panel to MAN.

NOTE: If optics testing will not be continued, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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6.2.11 OPTICS Coordinate Transformation Control Test

NOTE: Proceed with this test if 6.2.3 Operate Power on Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding.

6.2.11.1 Set/verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.11.2 Enter the following into the K-Start. Press the ENTER pushbutton after each entry:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.11.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the position indicated.

- a. TELESCOPE TRUNNION to SLAVE TO SXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to HI

6.2.11.4 Set up the analog recorders to monitor the following measurements:

- a. CG 3160 SCT Shaft Tachometer Output
- b. CG 3170 SCT Trunnion Tachometer Output

6.2.11.5 Enter the following into the K-Start to monitor the OPTICS CDU's.

VERB 16 NOUN 55, press ENTER

6.2.11.6 Set the OPTICS MODE switch on the G&N Panel to ZERO. Wait 15 seconds. Insure that the Optics zero properly by observing that R1 and R2 of the CRT indicate as follows:

- a. R1 = +000.00±000.03 (Shaft Angle)
- b. R2 = +00.000±000.06 (Trunnion LOS Angle)

Return the OPTICS MODE switch to MAN.

6.2.11.7 Using the OPTICS CONTROL STICK, drive the Optics until R1 = 225.00 and R2 = 10.000 on the CRT and the DSKY's.

6.2.11.8 Set the CONTROLLER COUPLING switch on the G&N Panel to RSLV and the controller speed switch to MED.

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6.2.11 OPTICS Coordinate Transformation Control Test

NOTE: Proceed with this test if 6.2.3 Operate Power on Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding.

- 6.2.11.1** Set/verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.
- 6.2.11.2** Enter the following into the K-Start. Press the ENTER pushbutton after each entry:
- a. VERB 41 NOUN 20, ENTER
 - b. +00000, ENTER
 - c. +00000, ENTER
 - d. +00000, ENTER
- 6.2.11.3** Verify and/or set the following switches on the G&N Indicator Control Panel to the position indicated.
- a. TELESCOPE TRUNNION to SLAVE TO SXT
 - b. CONTROLLER COUPLING to DIRECT
 - c. CONTROLLER SPEED to HI
- 6.2.11.4** Set up the analog recorders to monitor the following measurements:
- a. CG 3160 SCT Shaft Tachometer Output
 - b. CG 3170 SCT Trunnion Tachometer Output
- 6.2.11.5** Enter the following into the K-Start to monitor the OPTICS CDU's.
- VERB 16 NOUN 55, press ENTER
- 6.2.11.6** Set the OPTICS MODE switch on the G&N Panel to ZERO. Wait 15 seconds. Insure that the Optics zero properly by observing that R1 and R2 of the CRT indicate as follows:
- a. R1 = +000.00±000.03 (Shaft Angle)
 - b. R2 = +00.000±000.06 (Trunnion LOS Angle)
- Return the OPTICS MODE switch to MAN.
- 6.2.11.7** Using the OPTICS CONTROL STICK, drive the Optics until R1 = 225.00 and R2 = 10.000 on the CRT and the DSKY's.
- 6.2.11.8** Set the CONTROLLER COUPLING switch on the G&N Panel to RSLV and the controller speed switch to MED.

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- 6.2.11.9 Position the movable optics target such that it is centered on the SCT retical pattern, then start the analog recorders at a chart speed of 10 mm/second.
- 6.2.11.10 Quickly displace the OPTICS CONTROL STICK 45 ± 10 degrees in the upper right hand quadrant while sighting on the optics target through the SCT eyepiece. The target shall appear to move in the upper right field of view of the SCT at 45 ± 10 deg. Release the control stick when the target leaves the SCT upper right field of view, and immediately record the shaft angle as displayed on R1 of the CRT and DSKY's. The recorded shaft angle shall be $+225 \pm 10.00$ degrees.
- 6.2.11.11 Enter VERB 34 in the DSKY.
Press the ENTER pushbutton.
- 6.2.11.12 Stop the analog recorder and measure the elapsed time between the initial and the final signal null conditions for the two measurements. The elapsed time shall be 24 ± 6 seconds.
- 6.2.11.13 Set the CONTROLLER COUPLING switch on the G&N Panel to DIRECT and drive the Optics with the OPTICS CONTROL STICK until the shaft and trunnion angles as indicated on the SCT TPAC's are approximately zero, then repeat step 6.2.11.5.

NOTE: If Optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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- 6.2.11.9 Position the movable optics target such that it is centered on the SCT retical pattern, then start the analog recorders at a chart speed of 10 mm/second.
- 6.2.11.10 Quickly displace the OPTICS CONTROL STICK 45 ± 10 degrees in the upper right hand quadrant while sighting on the optics target through the SCT eyepiece. The target shall appear to move in the upper right field of view of the SCT at 45 ± 10 deg. Release the control stick when the target leaves the SCT upper right field of view, and immediately record the shaft angle as displayed on R1 of the CRT and DSKY's. The recorded shaft angle shall be $+225 \pm 10.00$ degrees.
- 6.2.11.11 Enter VERB 34 in the DSKY.
Press the ENTER pushbutton.
- 6.2.11.12 Stop the analog recorder and measure the elapsed time between the initial and the final signal null conditions for the two measurements. The elapsed time shall be 24 ± 6 seconds.
- 6.2.11.13 Set the CONTROLLER COUPLING switch on the G&N Panel to DIRECT and drive the Optics with the OPTICS CONTROL STICK until the shaft and trunnion angles as indicated on the SCT TPAC's are approximately zero, then repeat step 6.2.11.5.

NOTE: If Optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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- 6.2.12 Optics Positional Accuracy Test. Proceed with this test if 6.2.3 Operate Power On Test, or 6.2.5.2, Turn-On Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2, Turn On Procedure, before proceeding.
- NOTE: This test requires the use of the G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT StLOS before proceeding. Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.
- 6.2.12.1 Set/verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify the following:
- +28 VDC OPTX OPERATE BUS (CG 1530) is 28.8 ± 3 VDC. Record the indication on the CRT.
 - CG 1211 OPTX 28V 800 cps 1% 0 ph not flashing on CRT.
 - CG 1212 OPTX 800 cps 5% - 90 ph not flashing on CRT.
- 6.2.12.2 Enter the following sequence into the K-Start.
- VERB 41, NOUN 20, ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER
- 6.2.12.3 Insure that OPTICS Optics control switches on the G&N Indicator Control Panel are set as follows:
- OPTICS MODE TO MAN
 - CONTROLLER SPEED to LO
 - CONTROLLER COUPLING to DIRECT
 - TELESCOPE TRUNNION to SLAVE TO SXT
- 6.2.12.4 Set the OPTICS MODE switch to ZERO. After 20 seconds return the switch to MAN.
- 6.2.12.5 Resolution Checks
- 6.2.12.5.1 Sight through the SXT eyepiece. Using the OPTIC CONTROL STICK, adjust the SXT to obtain the best reflected field of view of the 5-inch autocollimator reticle engravings at the center of the field of view.

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- 6.2.12 Optics Positional Accuracy Test, Proceed with this test if 6.2.3 Operate Power On Test, or 6.2.5.2, Turn-On Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2, Turn On Procedure, before proceeding.
- NOTE: This test requires the use of the G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT StLOS before proceeding. Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.
- 6.2.12.1 Set/verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify the following:
- +28 VDC OPTX OPERATE BUS (CG 1530) is 28.8 ± 3 VDC. Record the indication on the CRT.
 - CG 1211 OPTX 28V 800 cps 1% 0 ph not flashing on CRT.
 - CG 1212 OPTX 800 cps 5% - 90 ph not flashing on CRT.
- 6.2.12.2 Enter the following sequence into the K-Start.
- VERB 41, NOUN 20, ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER
- 6.2.12.3 Insure that OPTICS Optics control switches on the G&N Indicator Control Panel are set as follows:
- OPTICS MODE TO MAN
 - CONTROLLER SPEED to LO
 - CONTROLLER COUPLING to DIRECT
 - TELESCOPE TRUNNION to SLAVE TO SXT
- 6.2.12.4 Set the OPTICS MODE switch to ZERO. After 20 seconds return the switch to MAN.
- 6.2.12.5 Resolution Checks
- 6.2.12.5.1 Sight through the SXT eyepiece. Using the OPTIC CONTROL STICK, adjust the SXT to obtain the best reflected field of view of the 5-inch autocollimator reticle engravings at the center of the field of view.

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- 6.2.12.5.2 Note that the autocollimator reticle contains a series of lines of different thickness and width. Each set of lines is marked with a number (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines. The SXT resolution shall be at least 10 arc-seconds at the center of the field of view.
- 6.2.12.5.3 Repeat 6.2.12.5.1 and 6.2.12.5.2 using the SCT and the SCT resolution chart. The SCT shall have a resolution of at least 3 arc-minutes at the center of the field of view.
- 6.2.12.6 Slave Telescope Mode Checks
- 6.2.12.6.1 Enter VERB 16 NOUN 55 into the K-Start, Press the ENTER pushbutton.
- 6.2.12.6.2 Set the OPTICS MODE switch on the Control Indicator Panel to ZERO. After 20 seconds return the OPTICS MODE switch to MAN.
- 6.2.12.6.3 Record the SXT Shaft and Trunnion angles as indicated by the TPAC and the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between the TPAC Shaft angle and the Shaft CDU angle shall be $\pm 0.11^\circ$ or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be $\pm 0.22^\circ$ or less.
- 6.2.12.6.4 Using the OPTICS CONTROL STICK and CONTROLLER SPEED switch, drive the SXT Shaft and Trunnion CDU's until R1 = $+035.00 \pm 0.10$ deg. and R2 = $+35.000 \pm 0.100$ deg. Record R1 and R2. Record the Shaft and Trunnion angles as indicated by the TPAC. The difference between the TPAC Shaft angle and Shaft CDU angle shall be $\pm 0.11^\circ$ or less. The difference between the TPAC Trunnion angle and Trunnion CDU angle shall be $\pm 0.22^\circ$ or less.
- 6.2.12.6.5 Set the OPTICS MODE switch to ZERO. After 20 seconds return the OPTICS MODE switch to MAN.
- 6.2.12.6.6 Set the TELESCOPE TRUNNION switch to the 0° position.

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- 6.2.12.5.2 Note that the autocollimator reticle contains a series of lines of different thickness and width. Each set of lines is marked with a number (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines. The SXT resolution shall be at least 10 arc-seconds at the center of the field of view.
- 6.2.12.5.3 Repeat 6.2.12.5.1 and 6.2.12.5.2 using the SCT and the SCT resolution chart. The SCT shall have a resolution of at least 3 arc-minutes at the center of the field of view.
- 6.2.12.6 Slave Telescope Mode Checks
- 6.2.12.6.1 Enter VERB 16 NOUN 55 into the K-Start, Press the ENTER pushbutton.
- 6.2.12.6.2 Set the OPTICS MODE switch on the Control Indicator Panel to ZERO. After 20 seconds return the OPTICS MODE switch to MAN.
- 6.2.12.6.3 Record the SCT Shaft and Trunnion angles as indicated by the TPAC and the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between the TPAC Shaft angle and the Shaft CDU angle shall be $\pm 0.11^\circ$ or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be $\pm 0.22^\circ$ or less.
- 6.2.12.6.4 Using the OPTICS CONTROL STICK and CONTROLLER SPEED switch, drive the SXT Shaft and Trunnion CDU's until R1 = $+035.00 \pm 0.10$ deg. and R2 = $+35.000 \pm 0.100$ deg. Record R1 and R2. Record the Shaft and Trunnion angles as indicated by the TPAC. The difference between the TPAC Shaft angle and Shaft CDU angle shall be $\pm 0.11^\circ$ or less. The difference between the TPAC Trunnion angle and Trunnion CDU angle shall be $\pm 0.22^\circ$ or less.
- 6.2.12.6.5 Set the OPTICS MODE switch to ZERO. After 20 seconds return the OPTICS MODE switch to MAN.
- 6.2.12.6.6 Set the TELESCOPE TRUNNION switch to the 0° position.

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6.2.12.6.7	Remove the plug from the base of the SXT eyepiece and install the Adapter Assembly and Portable Light Assembly. Turn on the light. NOTE: If needed to reduce external light, place a photographers hood over the optics head and retroreflecting prism.	
6.2.12.6.8	By sighting through the SCT eyepiece, position the Retroreflecting Prism, Model No. A23-200, to span between the SXT StLOS and SCT LOS such that the illumination from the backlight filament is clearly visible at the center of the field of view.	
6.2.12.6.9	Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Using the OPTICS CONTROL STICK, adjust the trunnion CDU to bring the SCT horizontal reticle line into coincidence with the SXT horizontal reticle line. Record the Trunnion CDU angle displayed in R2 as XX.XXX degrees. The difference between this angle and the corresponding angle recorded in 6.2.12.6.3 shall be $\pm 0.2^\circ$ or less.	
6.2.12.6.10	Replace the Portable Light in the adapter on the SXT eyepiece.	
6.2.12.6.11	Set the OPTICS MODE switch to ZERO. After 20 seconds return the OPTICS MODE switch to MAN. Set the TELESCOPE TRUNNION switch to SLAVE TO SXT.	
6.2.12.6.12	Temporarily disable the SCT TRUNNION electrical drive by carefully unscrewing the SCT TRUNNION Manual Drive until it just releases from the panel. Do not rotate further, as this would displace the SCT LOS from the desired reference position.	
6.2.12.6.13	Remove the Portable Light from the adapter and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in step 6.2.12.6.9. Again using the OPTICS CONTROL STICK, bring the SCT horizontal reticle line into coincidence with the SXT horizontal reticle. Record the Trunnion CDU angle displayed in R2. The difference between this angle and the corresponding angle measured in 6.2.12.6.3 shall be $\pm 0.2^\circ$ or less. Replace the Portable Light Assembly in the adapter.	
6.2.12.6.14	Replace the SCT TRUNNION Manual Drive in the panel.	
6.2.12.6.15	Use the OPTICS CONTROL STICK to drive the Trunnion CDU to $+25.000^\circ \pm 0.006^\circ$ as indicated on R2. Maintain the Shaft CDU at $000.00^\circ \pm 0.01^\circ$ as indicated on R1.	
6.2.12.6.16	Set the TELESCOPE TRUNNION switch to 25°. After 30 seconds has elapsed, record the TPAC Trunnion angle and Trunnion CDU angle displayed in R2. The difference shall be $\pm 0.22^\circ$ or less. Record the Shaft CDU angle displayed in R1.	
6.2.12.6.17	Temporarily disable the electrical drive to the SCT Trunnion and SCT Shaft by unscrewing the SCT Trunnion and Shaft Manual Drive items until they just release from the panel. Do not rotate further, as this would displace the SCT LOS from the desired reference position.	

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- 6.2.12.6.7 Remove the plug from the base of the SXT eyepiece and install the Adapter Assembly and Portable Light Assembly. Turn on the light.
NOTE: If needed to reduce external light, place a photographers hood over the optics head and retroreflecting prism.
- 6.2.12.6.8 By sighting through the SCT eyepiece, position the Retroreflecting Prism, Model No. A23-200, to span between the SXT StLOS and SCT LOS such that the illumination from the backlight filament is clearly visible at the center of the field of view.
- 6.2.12.6.9 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Using the OPTICS CONTROL STICK, adjust the trunnion CDU to bring the SCT horizontal reticle line into coincidence with the SXT horizontal reticle line. Record the Trunnion CDU angle displayed in R2 as XX.XXX degrees. The difference between this angle and the corresponding angle recorded in 6.2.12.6.3 shall be $\pm 0.2^\circ$ or less.
- 6.2.12.6.10 Replace the Portable Light in the adapter on the SXT eyepiece.
- 6.2.12.6.11 Set the OPTICS MODE switch to ZERO. After 20 seconds return the OPTICS MODE switch to MAN. Set the TELESCOPE TRUNNION switch to SLAVE TO SXT.
- 6.2.12.6.12 Temporarily disable the SCT TRUNNION electrical drive by carefully unscrewing the SCT TRUNNION Manual Drive until it just releases from the panel. Do not rotate further, as this would displace the SCT LOS from the desired reference position.
- 6.2.12.6.13 Remove the Portable Light from the adapter and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in step 6.2.12.6.9. Again using the OPTICS CONTROL STICK, bring the SCT horizontal reticle line into coincidence with the SXT horizontal reticle. Record the Trunnion CDU angle displayed in R2. The difference between this angle and the corresponding angle measured in 6.2.12.6.3 shall be $\pm 0.2^\circ$ or less. Replace the Portable Light Assembly in the adapter.
- 6.2.12.6.14 Replace the SCT TRUNNION Manual Drive in the panel.
- 6.2.12.6.15 Use the OPTICS CONTROL STICK to drive the Trunnion CDU to $+25.000^\circ \pm 0.006^\circ$ as indicated on R2. Maintain the Shaft CDU at $000.00^\circ \pm 0.01^\circ$ as indicated on R1.
- 6.2.12.6.16 Set the TELESCOPE TRUNNION switch to 25° . After 30 seconds has elapsed, record the TPAC Trunnion angle and Trunnion CDU angle displayed in R2. The difference shall be $\pm 0.22^\circ$ or less. Record the Shaft CDU angle displayed in R1.
- 6.2.12.6.17 Temporarily disable the electrical drive to the SCT Trunnion and SCT Shaft by unscrewing the SCT Trunnion and Shaft Manual Drive items until they just release from the panel. Do not rotate further, as this would displace the SCT LOS from the desired reference position.

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- 6.2.12.6.18 Reposition the Retroreflecting Prism so that it is inclined at an angle of 25° downward and spans the SCT LOS and SXT StLOS. Sight into the SCT and adjust the prism so that illumination from the backlight filament is again visible at the center of the field of view. Remove the Portable Light Assembly from the SXT eyepiece adapter and direct the light into the SCT eyepiece while sighting through the SXT eyepiece. Observe the comparison of SCT and SXT reticles. Adjust the Trunnion CDU and Shaft CDU angles with the OPTICS CONTROL STICK to bring the two reticle patterns into coincidence. Record the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between each of these angles and the respective angles recorded in 6.2.12.6.16 shall be ± 0.2 degrees or less.
- 6.2.12.6.19 Replace the SCT Shaft and Trunnion Manual Drive items. Replace the Portable Light Assembly in the adapter. Set the TELESCOPE TRUNNION switch to SLAVE TO SXT. Set the OPTICS MODE switch to ZERO. Wait 20 seconds and then set the OPTICS MODE to MAN. Remove the Retro-reflecting Prism and photographer's hood if used.
- 6.2.12.7 SXT Parallelism Tests
- 6.2.12.7.1 Using the OPTICS CONTROL STICK drive the SXT StLOS Trunnion to $+15.000^\circ \pm 2^\circ$ as indicated in R2 of the DSKY. Maintain a Shaft CDU angle of 000.00 ± 0.01 degrees.
- 6.2.12.7.2 Sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to superimpose the SXT LLOS horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.
- 6.2.12.7.3 Repeat 6.2.12.7.2 twice. Calculate and record the average of the three autocollimator readings.
- 6.2.12.7.4 Set the OPTICS MODE switch to ZERO. After 20 seconds return the OPTICS MODE switch to MAN.
- 6.2.12.7.5 Again sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to bring the SXT StLOS horizontal reticle and autocollimator horizontal filar images to coincide. Record the autocollimator reading.
- 6.2.12.7.6 Repeat 6.2.12.7.5 twice. Calculate and record the average of the three autocollimator readings. The average value obtained here shall not differ from that obtained in 6.2.12.7.3 by more than 10 arc seconds.
- 6.2.12.7.7 Using the OPTICS CONTROL STICK drive the SXT Trunnion angle to $85.000^\circ \pm 5^\circ$ as indicated on R2 of the DSKY. Set the CONTROLLER SPEED to LO and drive the SXT Trunnion to $+90.000^\circ \pm 0.006^\circ$ as indicated on R2 of the DSKY. Insure that the SXT Shaft angle remains at 000.00 ± 0.02 degrees as indicated by R1 on the DSKY.
- 6.2.12.7.8 Sight through the SXT. Two reticle patterns shall be visible. Use the OPTICS CONTROL STICK to adjust the SXT Trunnion angle until the two horizontal reticle lines are coincident. Record the Trunnion CDU angle displayed in R2. The Trunnion CDU angle shall be 90.000 ± 0.010 degrees.

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- 6.2.12.6.18 Reposition the Retroreflecting Prism so that it is inclined at an angle of 25° downward and spans the SCT LOS and SXT StLOS. Sight into the SCT and adjust the prism so that illumination from the backlight filament is again visible at the center of the field of view. Remove the Portable Light Assembly from the SXT eyepiece adapter and direct the light into the SCT eyepiece while sighting through the SXT eyepiece. Observe the comparison of SCT and SXT reticles. Adjust the Trunnion CDU and Shaft CDU angles with the OPTICS CONTROL STICK to bring the two reticle patterns into coincidence. Record the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between each of these angles and the respective angles recorded in 6.2.12.6.16 shall be ± 0.2 degrees or less.
- 6.2.12.6.19 Replace the SCT Shaft and Trunnion Manual Drive Items. Replace the Portable Light Assembly in the adapter. Set the TELESCOPE TRUNNION switch to SLAVE TO SXT. Set the OPTICS MODE switch to ZERO. Wait 20 seconds and then set the OPTICS MODE to MAN. Remove the Retro-reflecting Prism and photographer's hood if used.
- 6.2.12.7 SXT Parallelism Tests
- 6.2.12.7.1 Using the OPTICS CONTROL STICK drive the SXT StLOS Trunnion to $+15.000^\circ \pm 2^\circ$ as indicated in R2 of the DSKY. Maintain a Shaft CDU angle of 000.00 ± 0.01 degrees.
- 6.2.12.7.2 Sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to superimpose the SXT LLOS horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.
- 6.2.12.7.3 Repeat 6.2.12.7.2 twice. Calculate and record the average of the three autocollimator readings.
- 6.2.12.7.4 Set the OPTICS MODE switch to ZERO. After 20 seconds return the OPTICS MODE switch to MAN.
- 6.2.12.7.5 Again sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to bring the SXT StLOS horizontal reticle and autocollimator horizontal filar images to coincide. Record the autocollimator reading.
- 6.2.12.7.6 Repeat 6.2.12.7.5 twice. Calculate and record the average of the three autocollimator readings. The average value obtained here shall not differ from that obtained in 6.2.12.7.3 by more than 10 arc seconds.
- 6.2.12.7.7 Using the OPTICS CONTROL STICK drive the SXT Trunnion angle to $85.000^\circ \pm 5^\circ$ as indicated on R2 of the DSKY. Set the CONTROLLER SPEED to LO and drive the SXT Trunnion to $+90.000^\circ \pm 0.006^\circ$ as indicated on R2 of the DSKY. Insure that the SXT Shaft angle remains at 000.00 ± 0.02 degrees as indicated by R1 on the DSKY.
- 6.2.12.7.8 Sight through the SXT. Two reticle patterns shall be visible. Use the OPTICS CONTROL STICK to adjust the SXT Trunnion angle until the two horizontal reticle lines are coincident. Record the Trunnion CDU angle displayed in R2. The Trunnion CDU angle shall be 90.000 ± 0.010 degrees.

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- 6.2.12.7.9 Remove the Portable Light Assembly and Adapter Assembly from the base of the SXT eyepiece. Replace the SXT eyepiece plug.
NOTE: If Optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.
- 6.2.12.8 Shaft and Trunnion Positional Accuracy Checks.
- 6.2.12.8.1 Set the OPTICS MODE switch to ZERO. After 30 seconds, return the selector to MANUAL.
- 6.2.12.8.2 Sight through the SXT. Using the control stick align the SXT SLOS with optical target No. 1 on the G&N Installation Fixture Model No. A23-071.
- 6.2.12.8.3 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton. Record the value of R1 and R2 displayed on the CRT. Record the Shaft and Trunnion Angles from the TPAC.
- 6.2.12.8.4 Sight through the SXT. Using the control stick align the SXT SLOS with Optical Target No. 2 on A23-071.
- 6.2.12.8.5 Record the value in R1 and R2 on the CRT. Record the Shaft and Trunnion Angles from the TPAC.
- 6.2.12.8.6 Set the OPTICS MODE switch to ZERO. After 30 seconds set the switch to CMC.
- 6.2.12.8.7 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.8 Enter the value recorded from R1 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.9 Enter the value recorded from R2 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.10 Sight through the SXT. The SLOS should be centered on Optical Target No. 1 on A23-071. Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.3 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.11 Enter VERB 41 NOUN 55 into the K-START. Press the ENTER pushbutton.
- 6.2.12.8.12 Enter the value recorded from R1 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.13 Enter the value recorded from R2 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.

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- 6.2.12.7.9 Remove the Portable Light Assembly and Adapter Assembly from the base of the SXT eyepiece. Replace the SXT eyepiece plug.
NOTE: If Optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.
- 6.2.12.8 Shaft and Trunnion Positional Accuracy Checks.
- 6.2.12.8.1 Set the OPTICS MODE switch to ZERO. After 30 seconds, return the selector to MANUAL.
- 6.2.12.8.2 Sight through the SXT. Using the control stick align the SXT SLOS with optical target No. 1 on the G&N Installation Fixture Model No. A23-071.
- 6.2.12.8.3 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton. Record the value of R1 and R2 displayed on the CRT. Record the Shaft and Trunnion Angles from the TPAC.
- 6.2.12.8.4 Sight through the SXT. Using the control stick align the SXT SLOS with Optical Target No. 2 on A23-071.
- 6.2.12.8.5 Record the value in R1 and R2 on the CRT. Record the Shaft and Trunnion Angles from the TPAC.
- 6.2.12.8.6 Set the OPTICS MODE switch to ZERO. After 30 seconds set the switch to CMC.
- 6.2.12.8.7 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.8 Enter the value recorded from R1 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.9 Enter the value recorded from R2 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.10 Sight through the SXT. The SLOS should be centered on Optical Target No. 1 on A23-071. Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.3 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.11 Enter VERB 41 NOUN 55 into the K-START. Press the ENTER pushbutton.
- 6.2.12.8.12 Enter the value recorded from R1 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.13 Enter the value recorded from R2 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.

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- 6.2.12.8.14 Sight through the SXT. The SLOS should be centered on Optical Target No. 2 on A23-071. Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.5 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.15 Set the OPTICS MODE switch to ZERO. After 30 seconds return the switch to MANUAL.
- 6.2.12.8.16 Enter VERB 41 NOUN 20 into the K-START. Press the ENTER pushbutton. Enter +00000 into the K-START 3 times. Press the ENTER pushbutton after each entry,

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- 6.2.12.8.14 Sight through the SXT. The SLOS should be centered on Optical Target No. 2 on A23-071. Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.5 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.15 Set the OPTICS MODE switch to ZERO. After 30 seconds return the switch to MANUAL.
- 6.2.12.8.16 Enter VERB 41 NOUN 20 into the K-START. Press the ENTER pushbutton. Enter +00000 into the K-START 3 times. Press the ENTER pushbutton after each entry.

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- 6.2.13.1 Optics Slew Rate Test
- 6.2.13.2 Optics Slew Rate Test. If 6.2.13.1 Operate Power On Test has been completed and system operation has not been interrupted, it
- NOTE: Perform Master Initialization 6.2.5.3, before proceeding. Turn on power, and proceed.
- 6.2.13.1.1 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $+28.0 \pm 3.0$ VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.
- 6.2.13.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.
- VERB 41 NOUN 20, ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER
- 6.2.13.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the positions indicated.
- TELESCOPE TRUNNION to SLAVE to SXT
 - CONTROLLER COUPLING to DIRECT
 - CONTROLLER SPEED to HI
- 6.2.13.4 Monitor the OCDU's by entering VERB 16 NOUN 55 into K148. Press the ENTER pushbutton.
- 6.2.13.5 Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following data displayed in R1 and R2 on the DSKY.
- $R1 = +000.00 \pm 000.03$ (Shaft Angle)
 - $R2 = +00.000 \pm 00.006$ (Trunnion LOS Angle)
- Set the OPTICS MODE switch on the G&N Indicator Panel to MAN.
- NOTE: Read & understand step 6.2.13.6 before proceeding. Do not hold Control Stick at upper limit more than 10 seconds, or exceed a trunnion angle of 85°
- Trunnion Slew Rate - HI Speed
- 6.2.13.6 Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 5 seconds after the first mark, again press the MARK pushbutton and record the new display in R2 and R3. The data displayed is in the following form:
- $R2 = \pm XX.XXX$ (Trunnion LOS angle in deg.)
 - $R3 = +XXX.XX$ (Time in seconds)

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- Option Slew Rate Test
- 6.2.13** **Optics Slew Rate Test** To test if G&N Optics Power On Test has been completed and system operation has not been interrupted. If
- NOTE: Perform Master Initialization 6.2.5.3 before proceeding.** Run program, check processing.
- 6.2.13.1** Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $\pm 28.0 \pm 3.0$ VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.
- 6.2.13.2** Enter the following sequence into K148. Press the ENTER pushbutton after each entry.
- a. VERB 41 NOUN 20, ENTER
 - b. +00000, ENTER
 - c. +00000, ENTER
 - d. +00000, ENTER
- 6.2.13.3** Verify and/or set the following switches on the G&N Indicator Control Panel to the positions indicated.
- a. TELESCOPE TRUNNION to SLAVE to SXT
 - b. CONTROLLER COUPLING to DIRECT
 - c. CONTROLLER SPEED to HI
- 6.2.13.4** Monitor the OCDU's by entering VERB 16 NOUN 55 into K148. Press the ENTER pushbutton.
- 6.2.13.5** Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following data displayed in R1 and R2 on the DSKY.
- a. R1 = $+000.00 \pm 000.03$ (Shaft Angle)
 - b. R2 = $+00.000 \pm 00.006$ (Trunnion LOS Angle)
- Set the OPTICS MODE switch on the G&N Indicator Panel to MAN.
- NOTE:** Read & understand step 6.2.13.6 before proceeding. Do not hold Control Stick at upper limit more than 10 seconds, or exceed a trunnion angle of 85°
- Trunnion Slew Rate - HI Speed
- 6.2.13.6** Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 5 seconds after the first mark, again press the MARK pushbutton and record the new display in R2 and R3. The data displayed is in the following form:
- a. R2 = $\pm XX.XXX$ (Trunnion LOS angle in deg.)
 - b. R3 = $+XXX.XX$ (Time in seconds)

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6.2.13.7 Perform the following calculations:

- Difference between R2 displays = $\frac{\Delta \text{ trun. angle}}{\Delta \text{ time}}$
- Difference between R3 displays = $\frac{\Delta \text{ trun. angle}}{\Delta \text{ time}}$
- $\frac{\Delta \text{ trun. angle}}{\Delta \text{ time}} = \text{deg/sec}$

The Trunnion slew rate shall be $10 \pm 2 \text{ deg/sec}$.

Shaft Slew Rate - HI Speed

6.2.13.8 Using the Optics Control Stick, drive the Trunnion LOS Angle back to approximately zero degrees as indicated on the TPAC. Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read and understand step 6.2.13.9 before proceeding. Do not hold Control Stick at right limit for more than 10 seconds, or exceed a shaft angle of 250° .

6.2.13.9 Push and hold the Optics Control stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 5 seconds after the first mark, again press the MARK pushbutton and record the new display in R1 and R3. The data displayed is in the following form.

- R1 = + XXX.XX (Shaft angle in deg.)
R3 = + XXX.XX (Time in seconds)

6.2.13.10 Perform the following calculations

- Difference between R1 displays = $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}}$
- Difference between R3 displays = $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}}$
- $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \text{deg/sec}$

The Shaft Slew Rate shall be $19.5 \pm 3.9 \text{ deg/sec}$.

Trunnion Slew Rate - MED Speed

6.2.13.11 Using the Optics Control Stick, drive the shaft angle back to approximately zero degrees as indicated on the TPAC. Set the OPTICS MODE switch to zero. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to MED.

NOTE: Read & understand 6.2.13.12 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

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6.2.13.7 Perform the following calculations:

- a. Difference between R2 displays = --- (Δ trun. angle)
 b. Difference between R3 displays = --- (Δ time)
 c.

$$\frac{\Delta \text{ trun. angle}}{\Delta \text{ time}} = \text{--- deg/sec}$$

The Trunnion slew rate shall be 10 ± 2 deg/sec.

Shaft Slew Rate - HI Speed

- 6.2.13.8 Using the Optics Control Stick, drive the Trunnion LOS Angle back to approximately zero degrees as indicated on the TPAC. Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read and understand step 6.2.13.9 before proceeding. Do not hold Control Stick at right limit for more than 10 seconds, or exceed a shaft angle of 250° .

- 6.2.13.9 Push and hold the Optics Control stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 5 seconds after the first mark, again press the MARK pushbutton and record the new display in R1 and R3. The data displayed is in the following form.

R1 = + XXX.XX (Shaft angle in deg.)
 R3 = + XXX.XX (Time in seconds)

6.2.13.10 Perform the following calculations

- a. Difference between R1 displays = --- (Δ shaft angle)
 b. Difference between R3 displays = --- (Δ time)
 c.

$$\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \text{--- deg/sec}$$

The Shaft Slew Rate shall be 19.5 ± 3.9 deg/sec.

Trunnion Slew Rate - MED Speed

- 6.2.13.11 Using the Optics Control Stick, drive the shaft angle back to approximately zero degrees as indicated on the TPAC. Set the OPTICS MODE switch to zero. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to MED.

NOTE: Read & understand 6.2.13.12 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

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6.2.13.12 Push and hold the Optics Control stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 10 seconds after the first mark, again press the MARK pushbutton and record the new display in R2 & R3. The data displayed is in the following form:

- a. R2 = XX.XXX (Trunnion LOS Angle in degrees)
- b. R3 = XXX.XX (Time in seconds)

6.2.13.13 Perform the following calculations:

- a. Difference between R2 displays = ____ (Δ Trunnion Angle)
- b. Difference between R3 displays = ____ (Δ Time)

$$\frac{\Delta \text{ Trunnion angle}}{\Delta \text{ Time}} = \text{____ deg./sec}$$

The Trunnion slew rate shall be $1.0 \pm 0.2/\text{sec}$.

Shaft Slew Rate - MED Speed

6.2.13.14 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read & understand 6.2.13.15 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.15 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 10 seconds after the first mark, again press the MARK pushbutton and record the new display in R1 and R3. The data displayed is in the following form:

- a. R1 = ± XXX.XX (Shaft Angle in degrees)
- b. R3 = ± XXX.XX (Time in seconds)

6.2.13.16 Perform the following calculations

- a. Difference between R1 displays = ____ (Δ Shaft Angle)
- b. Difference between R3 displays = ____ (Δ Time)

$$\frac{\Delta \text{ Shaft Angle}}{\Delta \text{ Time}} = \text{____ deg/sec}$$

The Shaft Slew Rate shall be $2.0 \pm 0.4 \text{ deg/sec}$.

Trunnion Slew Rate - LO Speed

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6.2.13.12 Push and hold the Optics Control stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 10 seconds after the first mark, again press the MARK pushbutton and record the new display in R2 & R3. The data displayed is in the following form:

- a. R2 = XX.XXX (Trunnion LOS Angle in degrees)
- b. R3 = XXX.XX (Time in seconds)

6.2.13.13 Perform the following calculations:

- a. Difference between R2 displays = ____ . ____ (Δ Trunnion Angle)
- b. Difference between R3 displays = ____ . ____ (Δ Time)

$$\frac{\Delta \text{ Trunnion angle}}{\Delta \text{ Time}} = \text{____ deg./sec}$$

The Trunnion slew rate shall be $1.0 \pm 0.2/\text{sec}$.

Shaft Slew Rate - MED Speed

6.2.13.14 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read & understand 6.2.13.15 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.15 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 10 seconds after the first mark, again press the MARK pushbutton and record the new display in R1 and R3. The data displayed is in the following form:

- a. R1 = ± XXX.XX (Shaft Angle in degrees)
- b. R3 = ± XXX.XX (Time in seconds)

6.2.13.16 Perform the following calculations

- a. Difference between R1 displays = ____ . ____ (Δ Shaft Angle)
- b. Difference between R3 displays = ____ . ____ (Δ Time)

$$\frac{\Delta \text{ Shaft Angle}}{\Delta \text{ Time}} = \text{____ deg/sec}$$

The Shaft Slew Rate shall be $2.0 \pm 0.4 \text{ deg/sec}$.

Trunnion Slew Rate - LO Speed

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6.2.13.17 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to LO.

NOTE: Read and understand 6.2.13.18 before proceeding. Do not hold control stick at upper limit for more than 30 seconds.

6.2.13.18 Push and hold the Optics Control stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 10 seconds after the first mark, again press the MARK pushbutton and record the new display in R2 and R3. The data displayed is in the following form:

- a. R2 = XX.XXX (Trunnion LOS Angle in degrees)
- b. R3 = XXX.XX (Time in seconds)

6.2.13.19 Perform the following calculations

- a. Difference between R2 displays = XX.XXX (Δ Trunnion Angle)
- b. Difference between R3 displays = XXX.XX (Δ Time)
- c.
$$\frac{\Delta \text{ Trunnion Angle}}{\Delta \text{ Time}} = \text{---} \cdot \text{---} \text{ deg/sec}$$

The Trunnion Slew Rate shall be $0.10 \pm 0.02 \text{ deg/sec}$.

Shaft Slew Rate - LO Speed

6.2.13.20 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read and understand 6.2.13.21 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.21 Push and hold the Optics Control stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 10 seconds after the first mark, again press the MARK pushbutton and record the new display in R1 and R3. The data displayed is in the following form:

- a. R1 = XXX.XX (Shaft Angle in degrees)
- b. R3 = XXX.XX (Time in seconds)

6.2.13.22 Perform the following calculations:

- a. Difference between R1 displays = --- . --- (Δ Shaft Angle)
- b. Difference between R3 displays = --- . --- (Δ Time)
- c.
$$\frac{\Delta \text{ Shaft Angle}}{\Delta \text{ Time}} = \text{---} \cdot \text{---} \text{ deg/sec}$$

The Shaft Slew Rate shall be $0.20 \pm 0.04 \text{ deg/sec}$.

6.2.13.23 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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- 6.2.13.17 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to LO.

NOTE: Read and understand 6.2.13.18 before proceeding. Do not hold control stick at upper limit for more than 30 seconds.

- 6.2.13.18 Push and hold the Optics Control stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 10 seconds after the first mark, again press the MARK pushbutton and record the new display in R2 and R3. The data displayed is in the following form:

- a. R2 = XX.XXX (Trunnion LOS Angle in degrees)
- b. R3 = XXX.XX (Time in seconds)

- 6.2.13.19 Perform the following calculations

- a. Difference between R2 displays = XX.XXX (Δ Trunnion Angle)
- b. Difference between R3 displays = XXX.XX (Δ Time)
- c.
$$\frac{\Delta \text{ Trunnion Angle}}{\Delta \text{ Time}} = \text{--- deg/sec}$$

The Trunnion Slew Rate shall be 0.10 ± 0.02 deg/sec.

Shaft Slew Rate - LO Speed

- 6.2.13.20 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read and understand 6.2.13.21 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

- 6.2.13.21 Push and hold the Optics Control stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 10 seconds after the first mark, again press the MARK pushbutton and record the new display in R1 and R3. The data displayed is in the following form:

- a. R1 = XXX.XX (Shaft Angle in degrees)
- b. R3 = XXX.XX (Time in seconds)

- 6.2.13.22 Perform the following calculations:

- a. Difference between R1 displays = --- (Δ Shaft Angle)
- b. Difference between R3 displays = --- (Δ Time)
- c.
$$\frac{\Delta \text{ Shaft Angle}}{\Delta \text{ Time}} = \text{--- deg/sec}$$

The Shaft Slew Rate shall be 0.20 ± 0.04 deg/sec.

- 6.2.13.23 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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6.2.14 Stabilization Loop Step Response Test

6.2.14.1 Proceed with this test if the Operate Power On Test of 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding. Insure that the Carry-on Command Stimuli Unit, Model No. C14-200, is installed and connected.

6.2.14.2 Enter VERB 36 into K148. Press the ENTER pushbutton, then the ERROR RESET pushbutton.

6.2.14.3 Inner Gimbal Response Test

6.2.14.4.1 Enter code 2032000000 in C-START Module 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2117 IGA SERVO ERROR on 4A1-A3-CH1.

6.2.14.4.2 Enter VERB 41 NOUN 20 into K148. Press ENTER pushbutton.

6.2.14.4.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.

6.2.14.4.4 Enter VERB 42 into K148. Press ENTER.

6.2.14.4.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.

6.2.14.4.6 Enter 1000 into 4A2-A6-R155. The top part of the switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.

6.2.14.4.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the IG stabilization loop.

CAUTION: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.

6.2.14.4.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.

6.2.14.4.9 Enter 0000 into 4A2-A6-R155; the top part of switch should be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the IG Stabilization Loop. The bottom part of switch shall be extinguished.

6.2.14.4.10 After the transient has died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step input and the settling of the error signal to a value equal to $\pm 5\%$ percent of the original step amplitude. In addition, record the total number of overshoots.

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6.2.14 Stabilization Loop Step Response Test

6.2.14.1 Proceed with this test if the Operate Power On Test of 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding. Insure that the Carry-on Command Stimuli Unit, Model No. C14-200, is installed and connected.

6.2.14.2 Enter VERB 36 into K148. Press the ENTER pushbutton, then the ERROR RESET pushbutton.

6.2.14.3 Inner Gimbal Response Test

6.2.14.4.1 Enter code 2032000000 in C-START Module 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2117 IGA SERVO ERROR on 4A1-A3-CH1.

6.2.14.4.2 Enter VERB 41 NOUN 20 into K148. Press ENTER pushbutton.

6.2.14.4.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.

6.2.14.4.4 Enter VERB 42 into K148. Press ENTER.

6.2.14.4.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.

6.2.14.4.6 Enter 1000 into 4A2-A6-R155. The top part of the switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.

6.2.14.4.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the IG stabilization loop.

CAUTION: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/W POWER IMU switch on the LEB Lighting Control Panel to OFF.

6.2.14.4.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.

6.2.14.4.9 Enter 0000 into 4A2-A6-R155; the top part of switch should be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the IG Stabilization Loop. The bottom part of switch shall be extinguished.

6.2.14.4.10 After the transient has died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step input and the settling of the error signal to a value equal to 25 percent of the original step amplitude. In addition, record the total number of overshoots.

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- 6.2.14.4.10.1 The inner gimbal stabilization loop response time shall be less than 0.1 second.
- 6.2.14.4.10.2 The maximum number of overshoots on the IGA Servo Error signals shall be three.
- 6.2.14.5 Middle Gimbal Response Test
- 6.2.14.5.1 Enter code 2028000000 into C-START MODULE 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2147 MGA SERVO ERROR on 4A1-A3-CH1.
- 6.2.14.5.2 Enter VERB 41 NOUN 20 into K148. Press ENTER.
- 6.2.14.5.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.
- 6.2.14.5.4 Enter VERB 42 into K148. Press ENTER.
- 6.2.14.5.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.
- 6.2.14.5.6 Enter 0100 into 4A2-A6-R155. The top part of switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.
- 6.2.14.5.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the MG Stabilization Loop.
- CAUTION: If the transient caused by the step input does not die within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.
- 6.2.14.5.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.
- 6.2.14.5.9 Enter 0000 into 4A2-A6-R155. The top part of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press XEQ/SEAL pushbutton to remove the step input to the MG stabilization loop.
- 6.2.14.5.10 After the transients have died out, stop the analog recorder. Record the stab loop response time by measuring the time interval between removing the step input and the settling of the error signals to a value equal to ± 5 percent of the original step amplitude. In addition, record the total number of overshoots.
- 6.2.14.5.10.1 The middle gimbal stabilization loop response time shall be less than 0.1 second.
- 6.2.14.5.10.2 The maximum number of overshoots on the MGA Servo Error signals shall be three.

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- 6.2.14.4.10.1 The inner gimbal stabilization loop response time shall be less than 0.1 second.
- 6.2.14.4.10.2 The maximum number of overshoots on the IGA Servo Error signals shall be three.
- 6.2.14.5 Middle Gimbal Response Test
- 6.2.14.5.1 Enter code 2028000000 into C-START MODULE 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2147 MGA SERVO ERROR on 4A1-A3-CHI.
- 6.2.14.5.2 Enter VERB 41 NOUN 20 into K148. Press ENTER.
- 6.2.14.5.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.
- 6.2.14.5.4 Enter VERB 42 into K148. Press ENTER.
- 6.2.14.5.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.
- 6.2.14.5.6 Enter 0100 into 4A2-A6-R155. The top part of switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.
- 6.2.14.5.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the MG Stabilization Loop.
- CAUTION: If the transient caused by the step input does not die within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.
- 6.2.14.5.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.
- 6.2.14.5.9 Enter 0000 into 4A2-A6-R155. The top part of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press XEQ/SEAL pushbutton to remove the step input to the MG stabilization loop.
- 6.2.14.5.10 After the transients have died out, stop the analog recorder. Record the stab loop response time by measuring the time interval between removing the step input and the settling of the error signals to a value equal to ± 5 percent of the original step amplitude. In addition, record the total number of overshoots.
- 6.2.14.5.10.1 The middle gimbal stabilization loop response time shall be less than 0.1 second.
- 6.2.14.5.10.2 The maximum number of overshoots on the MGA Servo Error signals shall be three.

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6.2.14.6 Outer Gimbal Response Test

6.2.14.6.1 Enter code 2026000000 in C-START Module 4A1-A5-C156. Press XEQ/SEAL Pushbutton to call up CG 2177 OGA SERVO ERROR on 4A1-A3-OH1.

6.2.14.6.2 Enter VERB 41 NOUN 20 into K148. Press ENTER.

6.2.14.6.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.

6.2.14.6.4 Enter VERB 42 into K148. Press ENTER pushbutton.

6.2.14.6.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.

6.2.14.6.6 Enter 0010 into 4A2-A6-R155. The top half of the switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.

6.2.14.6.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the OG Stabilization Loops.

NOTE: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.

6.2.14.6.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.

6.2.14.6.9 Enter 0000 into 4A2-A6-R155. The top half of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the OG Stabilization Loop.

6.2.14.6.10 After the transients have died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step input and the settling of the error signal to a value equal to ± 5 percent of the original step amplitude. In addition, record the total number of overshoots.

6.2.14.6.10.1 The outer gimbal stabilization loop response time shall be less than 0.3 second.

6.2.14.6.10.2 The maximum number of overshoots on the OGA Servo Error Signals shall be three.

6.2.14.7 Enter VERB 40 NOUN 20 into K148. Press the ENTER pushbutton.

6.2.14.7.1 Enter VERB 41 NOUN 20 into K148. Press the ENTER pushbutton.

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6.2.14.6 Outer Gimbal Response Test

6.2.14.6.1 Enter code 2026000000 in C-START Module 4A1-A5-C156. Press XEQ/SEAL Pushbutton to call up CG 2177 OGA SERVO ERROR on 4A1-A3-OH1.

6.2.14.6.2 Enter VERB 41 NOUN 20 into K148. Press ENTER.

6.2.14.6.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.

6.2.14.6.4 Enter VERB 42 into K148. Press ENTER pushbutton.

6.2.14.6.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.

6.2.14.6.6 Enter 0010 into 4A2-A6-R155. The top half of the switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.

6.2.14.6.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the OG Stabilization Loops.

NOTE: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.

6.2.14.6.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.

6.2.14.6.9 Enter 0000 into 4A2-A6-R155. The top half of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the OG Stabilization Loop.

6.2.14.6.10 After the transients have died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step input and the settling of the error signal to a value equal to ± 5 percent of the original step amplitude. In addition, record the total number of overshoots.

6.2.14.6.10.1 The outer gimbal stabilization loop response time shall be less than 0.3 second.

6.2.14.6.10.2 The maximum number of overshoots on the OGA Servo Error Signals shall be three.

6.2.14.7 Enter VERB 40 NOUN 20 into K148. Press the ENTER pushbutton.

6.2.14.7.1 Enter VERB 41 NOUN 20 into K148. Press the ENTER pushbutton.

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- 6.2.14.7.2 Enter +00000 into K148. Press the ENTER pushbutton.
- 6.2.14.7.3 Enter +00000 into K148. Press the ENTER pushbutton.
- 6.2.14.7.4 Enter +00000 into K148. Press the ENTER pushbutton.



Figure 1. Typical Step Input Response

Figure 1. Typical Step Input Response

- 6.2.15.1 IRIG Scale Factor Test
- 6.2.15.1 Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.15.2 Verify that the IMU OPERATE power has been applied for a minimum of 1 hour, and that at least 1 hour has elapsed since running of the Gimbal Friction Test, 6.2.7.
- 6.2.15.3 Set up the Analog Recorders to monitor the following signals:
- a. CG 2117 IG SERVO ERROR
 - b. CG 2147 MG SERVO ERROR
 - c. CG 2177 OG SERVO ERROR
 - d. CG 2120 IG TM CURRENT
 - e. CG 2150 MG TM CURRENT
 - f. CG 2180 OG TM CURRENT
- 6.2.15.3.1 Start the analog recorder chart drive using a chart speed of 1 mm/sec. The recorder shall run for the duration of 6.2.15.
- 6.2.15.4 Enter VERB 57 into K148. Press the ENTER pushbutton.
- 6.2.15.5 Enter 00005 into K148. Press the ENTER pushbutton.
- 6.2.15.6 VERB 06 NOUN 61 shall flash on CRT and the following displayed in R1 and R2:
- R1 = ~~xxxxxx~~ (some Nav. Base azimuth)
- R2 = ~~xxxxxx~~ (some test site latitude; see Table I)

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- 6.2.14.7.2 Enter +00000 into K148. Press the ENTER pushbutton.
- 6.2.14.7.3 Enter +00000 into K148. Press the ENTER pushbutton.
- 6.2.14.7.4 Enter +00000 into K148. Press the ENTER pushbutton.

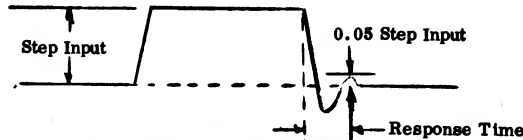


Figure 1. Typical Step Input Response

- 6.2.15.1 **IRIG Scale Factor Test**
- 6.2.15.1 Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.15.2 Verify that the IMU OPERATE power has been applied for a minimum of 1 hour, and that at least 1 hour has elapsed since running of the Gimbal Friction Test, 6.2.7.
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- 6.2.15.3.1 Start the analog recorder chart drive using a chart speed of 1 mm/sec. The recorder shall run for the duration of 6.2.15.
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- 6.2.15.6 VERB 06 NOUN 61 shall flash on CRT and the following displayed in R1 and R2:
- R1 = ~~xxxxxx~~ (some Nav. Base azimuth)
- R2 = ~~xxxxxx~~ (some test site latitude; see Table I)

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6.2.15.7 If the values displayed in R1 and R2 are correct, proceed with test, if not perform the following sequence:

- a. To correct R1, on the K-start enter VERB 21, press ENTER pushbutton, ~~xxxx.xx~~, press ENTER (~~xxxx.xx~~ is correct nav. base azimuth).
- b. To correct R2, on the K-start enter VERB 22, press ENTER pushbutton, ~~xx.xxx~~, press ENTER (obtain correct site latitude from Table I).

Table I

Site	Latitude
NAA	+33.921
MSC	+29.556
MILA	+28.516

6.2.15.8 Verify the correct displays on CRT R1 and R2, then on the K-start enter VERB 33 and press ENTER pushbutton.

6.2.15.9 VERB 21 NOUW 30 shall flash on the CRT, requesting a load of the test number.

Enter the desired test number from Table I and press the ENTER pushbutton.

Table I. Test Numbers and Positions for IRIG Tests

Test Number	Gyro Being Tested and Direction of Torque
+00001	+X
+00002	+Y
+00003	+Z
-00001	-X
-00002	-Y
-00003	-Z

NOTE: If all gyros are being tested, the test must be repeated once for each Test Number in Table I in the sequence listed. If only one gyro is being tested, the test need only be repeated for the two applicable Test Numbers.

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6.2.15.7 If the values displayed in R1 and R2 are correct, proceed with test, if not perform the following sequence:

- To correct R1, on the K-start enter VERB 21, press ENTER pushbutton, ~~xxxx.xx~~, press ENTER (~~xxxx.xx~~ is correct nav. base azimuth).
- To correct R2, on the K-start enter VERB 22, press ENTER pushbutton, ~~xx.xxx~~, press ENTER (obtain correct site latitude from Table I).

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NAA	+33.921
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Test Number	Gyro Being Tested and Direction of Torque
+00001	+X
+00002	+Y
+00003	+Z
-00001	-X
-00002	-Y
-00003	-Z

NOTE: If all gyros are being tested, the test must be repeated once for each Test Number in Table I in the sequence listed. If only one gyro is being tested, the test need only be repeated for the two applicable Test Numbers.

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- 6.2.15.10 After 160 seconds VERB 06 NOUN 66 shall flash on the CRT. Record the value displayed in register R1 for the appropriate Test Number in Table 2. The data displayed in the Scale Factor error in parts per million. The recorded Scale Factor error shall not exceed ± 1750 ppm.

Table 2. Display of Test Parameters

<u>Test Number</u>	<u>Symbol</u>	<u>Display in R1</u>
-00001	E+X	$\pm 0000X$
+00001	E-X	$\pm 0000X$
-00002	E+Y	$\pm 0000X$
+00002	E-Y	$\pm 0000X$
-00003	E+Z	$\pm 0000X$
+00003	E-Z	$\pm 0000X$

- 6.2.15.11 Enter VERB 33 into K148. Press the ENTER pushbutton.
- 6.2.15.12 Repeat 6.2.15.9 through 6.2.15.10 until all Test Numbers in Table I have been utilized.
- 6.2.15.13 Enter VERB 34 into K148. Press the ENTER pushbutton.
- 6.2.15.13.1 After completion of all test numbers, stop the analog recorders.
- 6.2.15.14 Enter VERB 40 NOUN 20 in K143. Press the ENTER pushbutton.
- 6.2.15.14.1 Enter VERB 41 NOUN 20 into K148. Press the ENTER pushbutton.
- 6.2.15.14.2 Enter +00000 into K148 three times, pressing the ENTER pushbutton after each entry.
- 6.2.16 IMU Performance Test
- 6.2.16.1 Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.16.2 Enter VERB 01 NOUN 10 into K148. Press the ENTER pushbutton. Enter 00003 into K148. Press the ENTER pushbutton. Record R1 = AAAAA and the time of day.
- 6.2.16.3 Enter VERB 21 NOUN 02 into K148. Press the ENTER pushbutton. Enter 01300 into K148. Press ENTER. Enter AAAAA into K148. Press ENTER.
- 6.2.16.4 Enter VERB 06 NOUN 02 into K148. Press ENTER. Enter 01300 into K148. Press ENTER. Record R1 = BBBBB.

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- 6.2.15.10 After 160 seconds VERB 06 NOUN 66 shall flash on the CRT. Record the value displayed in register R1 for the appropriate Test Number in Table 2. The data displayed in the Scale Factor error in parts per million. The recorded Scale Factor error shall not exceed ± 1750 ppm.

Table 2. Display of Test Parameters

<u>Test Number</u>	<u>Symbol</u>	<u>Display in R1</u>
-00001	E+X	±XXXXX
+00001	E-X	±XXXXX
-00002	E+Y	±XXXXX
+00002	E-Y	±XXXXX
-00003	E+Z	±XXXXX
+00003	E-Z	±XXXXX'

- 6.2.15.11 Enter VERB 33 into K148. Press the ENTER pushbutton.
- 6.2.15.12 Repeat 6.2.15.9 through 6.2.15.10 until all Test Numbers in Table I have been utilized.
- 6.2.15.13 Enter VERB 34 into K148. Press the ENTER pushbutton.
- 6.2.15.13.1 After completion of all test numbers, stop the analog recorders.
- 6.2.15.14 Enter VERB 40 NOUN 20 in K143. Press the ENTER pushbutton.
- 6.2.15.14.1 Enter VERB 41 NOUN 20 into K148. Press the ENTER pushbutton.
- 6.2.15.14.2 Enter +00000 into K148 three times, pressing the ENTER pushbutton after each entry.
- 6.2.16 IMU Performance Test
- 6.2.16.1 Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.16.2 Enter VERB 01 NOUN 10 into K148. Press the ENTER pushbutton. Enter 00003 into K148. Press the ENTER pushbutton. Record R1 = AAAAA and the time of day.
- 6.2.16.3 Enter VERB 21 NOUN 02 into K148. Press the ENTER pushbutton. Enter 01300 into K148. Press ENTER. Enter AAAAA into K148. Press ENTER.
- 6.2.16.4 Enter VERB 06 NOUN 02 into K148. Press ENTER. Enter 01300 into K148. Press ENTER. Record R1 = BBBBB.

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6.2.16.5 Perform the following calculations:

- a. $\frac{R1 (BBBBB) \times 5.12}{3600} = CCCC.C$ (hrs. in high order scaler channel 3)
- b. $23.3 - CCC.C = DDDDD$ Hrs.
- c. Add DDDDD to time of day recorded in step 1.

Do Not enter any of the PIPA scale factor tests within -0.2 hours of the time of day calculated in step 6.2.16.5c. This is the time at which the high order scaler, channel 3, will overflow. If a PIPA scale factor test is being performed at this time, unacceptable test results will occur.

6.2.16.6 Verify that the IMU Operate Power has been applied for at least one hour.

6.2.16.7 Test Initiation.

6.2.16.7.1 Enter the following into K148.

- a. VERB 01 NOUN 01, ENTER
 - b. 00362, ENTER
- Record R1 = XXXXY

6.2.16.7.2 Enter the following into K148

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table XV and XXXX is that recorded in 6.2.16.7.1.

TABLE XV

Y (from 6.2.16.7.1)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.16.7.3 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.16.7.4 Enter 00001 into K148. Press the ENTER pushbutton.

6.2.16.7.5 VERB 06 NOUN 61 shall appear flashing on CRT and will contain the following information:

R1 = xxx.xx (Some NB Azimuth)
R2 = xx.xxx (Some Test Site Latitude)

Insure that R1 = Correct NB Azimuth and R2 = Present Test Site Latitude from Table XX.

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6.2.16.5 Perform the following calculations:

- a. $\frac{R1 (BBBBB) \times 5.12}{3600} = CCCC.C$ (hrs. in high order scaler channel 3)
- b. $23.3 - CCC.C = DDDDD$ Hrs.
- c. Add DDDDD to time of day recorded in step 1.

Do Not enter any of the PIPA scale factor tests within -0.2 hours of the time of day calculated in step 6.2.16.5c. This is the time at which the high order scaler, channel 3, will overflow. If a PIPA scale factor test is being performed at this time, unacceptable test results will occur.

6.2.16.6 Verify that the IMU Operate Power has been applied for at least one hour.

6.2.16.7 Test Initiation.

6.2.16.7.1 Enter the following into K148.

- a. VERB 01 NOUN 01, ENTER
 - b. 00362, ENTER
- Record R1 = XXXXY

6.2.16.7.2 Enter the following into K148

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table XV and XXXX is that recorded in 6.2.16.7.1.

TABLE XV

Y (from 6.2.16.7.1)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.16.7.3 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.16.7.4 Enter 00001 into K148. Press the ENTER pushbutton.

6.2.16.7.5 VERB 06 NOUN 61 shall appear flashing on CRT and will contain the following information:

R1 = xxx.xx (Some NB Azimuth)
R2 = xx.xxx (Some Test Site Latitude)

Insure that R1 = Correct NB Azimuth and R2 = Present Test Site Latitude from Table XX.

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6.2.16.7.6 If R1 does not contain the correct NB Azimuth, enter the following sequence into K148.

- a. VERB 21, ENTER
- b. +xxx.xx, ENTER (where +xxxxx is the NB Azimuth)

6.2.16.7.7 If R2 does not contain present Test Site Latitude enter the following sequence into K148:

- a. VERB 22, ENTER
- b. Proper Data from Table XX, ENTER

Table XX

<u>Location</u>	<u>Latitude</u>
NAA	+33.921
MSC	+29.556
MILA	+28.516

6.2.16.7.8 Enter VERB 33 into K148. Press ENTER pushbutton.

6.2.16.7.9 VERB 06 NOUN 66 shall appear flashing on CRT. Verify that the following values appear on CRT.

R1 = +00900
R2 = +00000
R3 = +00001

6.2.1.6.7.10 If the contents of R1 on the CRT are not +00900, enter the following sequence into K148.

- a. VERB 21, ENTER
- b. +00900, ENTER

6.2.16.7.11 If the contents of R3 on the CRT are not +00000, enter the following sequence into K148:

- a. VERB 22, ENTER
- b. +00000, ENTER

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6.2.16.7.6 If R1 does not contain the correct NB Azimuth, enter the following sequence into K148.

- a. VERB 21, ENTER
- b. +xxx.xx, ENTER (where +xxxxx is the NB Azimuth)

6.2.16.7.7 If R2 does not contain present Test Site Latitude enter the following sequence into K148:

- a. VERB 22, ENTER
- b. Proper Data from Table XX, ENTER

Table XX

<u>Location</u>	<u>Latitude</u>
NAA	+33.921
MSC	+29.556
MILA	+28.516

6.2.16.7.8 Enter VERB 33 into K148. Press ENTER pushbutton.

6.2.16.7.9 VERB 06 NOUN 66 shall appear flashing on CRT. Verify that the following values appear on CRT.

R1 = +00900
R2 = +00000
R3 = +00001

6.2.16.7.10 If the contents of R1 on the CRT are not +00900, enter the following sequence into K148.

- a. VERB 21, ENTER
- b. +00900, ENTER

6.2.16.7.11 If the contents of R3 on the CRT are not +00000, enter the following sequence into K148:

- a. VERB 22, ENTER
- b. +00000, ENTER

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- 6.2.16.7.12 If the contents of R3 on the CRT are not +00001, enter the following sequence into K148;
- a. VERB 23, ENTER
 - b. +00001, ENTER
- 6.2.16.7.13 Verify correct display in R1, R2, and R3. Enter VERB 33 into K148. Press the ENTER pushbutton.
- 6.2.16.7.14 After approximately 17 minutes, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the value of CRT for R2 on the calculation sheet.
- 6.2.16.7.15 Enter VERB 33 into K148. Press the ENTER pushbutton.
- 6.2.16.7.16 After approximately 90 sec, VERB 06, NOUN 66 shall appear flashing on the CRT. Record the value on CRT for R1 and R2 on the calculation sheet.
- 6.2.16.7.17 Enter VERB 34 into K148. Press the ENTER pushbutton.
- 6.2.16.7.18 Repeat steps 6.2.16.3.7 through 6.2.16.3.14, substituting position number +00002 in R3.
- 6.2.16.7.19 Enter VERB 33 into K148. Press ENTER pushbutton.
- 6.2.16.7.20 After approximately 67 minutes, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the value on CRT for R2 on the calculation sheet.
- 6.2.16.7.21 Repeat steps 6.2.16.3.6 through 6.2.16.3.14, substituting position number +00003 in R3.
- 6.2.16.7.22 Repeat steps 6.2.16.3.15 through 6.2.16.3.18, substituting position number +00004 in R3.
- 6.2.16.7.23 Enter VERB 33 into K148. Press ENTER pushbutton.

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- 6.2.16.7.12 If the contents of R3 on the CRT are not +00001, enter the following sequence into K148:
- a. VERB 23, ENTER
 - b. +00001, ENTER
- 6.2.16.7.13 Verify correct display in R1, R2, and R3. Enter VERB 33 into K148. Press the ENTER pushbutton.
- 6.2.16.7.14 After approximately 17 minutes, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the value of CRT for R2 on the calculation sheet.
- 6.2.16.7.15 Enter VERB 33 into K148. Press the ENTER pushbutton.
- 6.2.16.7.16 After approximately 90 sec, VERB 06, NOUN 66 shall appear flashing on the CRT. Record the value on CRT for R1 and R2 on the calculation sheet.
- 6.2.16.7.17 Enter VERB 34 into K148. Press the ENTER pushbutton.
- 6.2.16.7.18 Repeat steps 6.2.16.3.7 through 6.2.16.3.14, substituting position number +00002 in R3.
- 6.2.16.7.19 Enter VERB 33 into K148. Press ENTER pushbutton.
- 6.2.16.7.20 After approximately 67 minutes, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the value on CRT for R2 on the calculation sheet.
- 6.2.16.7.21 Repeat steps 6.2.16.3.6 through 6.2.16.3.14, substituting position number +00003 in R3.
- 6.2.16.7.22 Repeat steps 6.2.16.3.15 through 6.2.16.3.18, substituting position number +00004 in R3.
- 6.2.16.7.23 Enter VERB 33 into K148. Press ENTER pushbutton.

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6.2.16.7.24 VERB 06 NOUN 66 shall flash on the CRT. Verify the following data is also displayed on the CRT.

- a. R1 = +00900
- b. R2 = +00000
- c. R3 = +00005

If data is incorrect perform steps 6.2.16.3.8 thru 6.2.16.3.10 entering the correct data. Enter VERB 33 into K148. Press ENTER pushbutton.

The PROGRAM ALARM and GIMBAL LOCK status lights shall be illuminated on the DSKY.

6.2.16.7.25 Press the RESET pushbutton. The Program Alarm lamp shall extinguish. In approximately 90 sec, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the data displayed in R1 and R2 on the CRT.

6.2.16.7.26 Enter VERB 34 into K148. Press ENTER pushbutton. Repeat steps 6.2.16.3.22 thru 6.2.16.3.23 substituting position no. +00006.

6.2.16.7.27 Enter VERB 34 into K148. Press the ENTER pushbutton. VERB 06 NOUN 66 shall flash on the CRT. Verify the following data is also displayed on the CRT.

- a. R1 = +00900
- b. R2 = +00000
- c. R3 = +00007

If the data is incorrect perform steps 6.2.16.3.8 thru 6.2.16.3.10 entering the correct data.

6.2.16.7.28 Enter VERB 33 into K148. Press ENTER pushbutton. The GIMBAL LOCK status lamp shall extinguish. In approximately 17 minutes VERB 06 NOUN 66 shall flash on the CRT. Record the data displayed in R2 of the CRT.

6.2.16.7.29 Repeat steps 6.2.16.3.25 and 6.2.16.3.26 substituting position no. +00008 in R3.

6.2.16.7.30 Repeat steps 6.2.16.3.25 and 6.2.16.3.26 substituting position no. +00009 in R3.

6.2.16.7.31 Repeat steps 6.2.16.3.25 and 6.2.16.3.26 substituting position no. +00010 in R3.

6.2.16.8 To terminate the IMU Performance Test, enter VERB 36 into K148. Press ENTER pushbutton.

6.2.16.9 Enter the following sequence in K148.

- a. VERB 40 NOUN 20, ENTER
- b. VERB 41 NOUN 20, ENTER
- c. +00000, ENTER
- d. +00000, ENTER
- e. +00000, ENTER

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6.2.16.7.24 VERB 06 NOUN 66 shall flash on the CRT. Verify the following data is also displayed on the CRT.

- a. R1 = +00900
- b. R2 = +00000
- c. R3 = +00005

If data is incorrect perform steps 6.2.16.3.8 thru 6.2.16.3.10 entering the correct data. Enter VERB 33 into K148. Press ENTER pushbutton.

The PROGRAM ALARM and GIMBAL LOCK status lights shall be illuminated on the DSKY.

6.2.16.7.25 Press the RESET pushbutton. The Program Alarm lamp shall extinguish. In approximately 90 sec, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the data displayed in R1 and R2 on the CRT.

6.2.16.7.26 Enter VERB 34 into K148. Press ENTER pushbutton. Repeat steps 6.2.16.3.22 thru 6.2.16.3.23 substituting position no. +00006.

6.2.16.7.27 Enter VERB 34 into K148. Press the ENTER pushbutton. VERB 06 NOUN 66 shall flash on the CRT. Verify the following data is also displayed on the CRT.

- a. R1 = +00900
- b. R2 = +00000
- c. R3 = +00007

If the data is incorrect perform steps 6.2.16.3.8 thru 6.2.16.3.10 entering the correct data.

6.2.16.7.28 Enter VERB 33 into K148. Press ENTER pushbutton. The GIMBAL LOCK status lamp shall extinguish. In approximately 17 minutes VERB 06 NOUN 66 shall flash on the CRT. Record the data displayed in R2 of the CRT.

6.2.16.7.29 Repeat steps 6.2.16.3.25 and 6.2.16.3.26 substituting position no. +00008 in R3.

6.2.16.7.30 Repeat steps 6.2.16.3.25 and 6.2.16.3.26 substituting position no. +00009 in R3.

6.2.16.7.31 Repeat steps 6.2.16.3.25 and 6.2.16.3.26 substituting position no. +00010 in R3.

6.2.16.8 To terminate the IMU Performance Test, enter VERB 36 into K148. Press ENTER pushbutton.

6.2.16.9 Enter the following sequence in K148.

- a. VERB 40 NOUN 20, ENTER
- b. VERB 41 NOUN 20, ENTER
- c. +00000, ENTER
- d. +00000, ENTER
- e. +00000, ENTER

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6.2.16.10 Calculations

Table XXI

Position No. As Displayed in R3	Quantity Being Measured
+00001	+NEDY +X PIPA G
+00002	+NEDZ -X PIPA G -NEDX + ADIAX
+00003	-NEDX +Z PIPA G
+00004	+NEDY + ADSRAY -Z PIPA G +NEDZ + ADIAZ
+00005	+ Y PIPA G
+00006	- Y PIPA G
+00007	-NEDX + .707 ADSRAX
+00008	.707 (-NEDZ - NEDY) + .5 (ADIAZ - ADIAX) +.5 (ADSRAY + ADSRAZ)
+00009	-NEDZ + .707 ADSRAZ
+00010	.707 (NEDY - NEDX) + .5 (ADIAX - ADIAY) +.5 (ADSRAX)

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6.2.16.10 Calculations

Table XXI

Position No. As Displayed in R3	Quantity Being Measured
+00001	+NBDY +X PIPA G
+00002	+NBDZ -X PIPA G -NBDX + ADIAX
+00003	-NBDX +Z PIPA G
+00004	+NBDY + ADSRAY -Z PIPA G +NBDZ + ADIAZ
+00005	+ Y PIPA G
+00006	- Y PIPA G
+00007	-NBDX + .707 ADSRAX
+00008	.707 (-NBDZ - NBDY) + .5 (ADIAZ - ADIAY) +.5 (ADSRAY + ADSRAZ)
+00009	-NBDZ + .707 ADSRAZ
+00010	.707 (NBDY - NBDX) + .5 (ADIAY - ADIAX) +.5 (ADSRAX)

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6.2.16.10.1 Measured Values

	Line	Position No.	Step No.	Parameter	Recorded Value
6.2.16.10.1.1	1	+00001	6.2.16.7.12	+NBDY	R2
6.2.16.10.1.2	2	+00001	6.2.16.7.14	+XPIPAG	R1 . R2
6.2.16.10.1.3	3	+00002	6.2.16.7.12	+NBDZ	R2
6.2.16.10.1.4	4	+00002	6.2.16.7.14	-XPIPAG	R1 . R2
6.2.16.10.1.5	5	+00002	6.2.16.7.18	-NGDX + ADLAX	R2
6.2.16.10.1.6	6	+00003	6.2.16.7.12	-NBDX	R2
6.2.16.10.1.7	7	+00003	6.2.16.7.14	+ZPIPAG	R1 . R2
6.2.16.10.1.8	8	+00004	6.2.16.7.12	+NBDY + ADSRAY	R2
6.2.16.10.1.9	9	+00004	6.2.16.7.14	-ZPIPAG	R1 . R2
6.2.16.10.1.10	10	+00004	6.2.16.7.18	+NBDZ + ADLAX	R2
6.2.16.10.1.11	11	+00005	6.2.16.7.23	+YPIPAG	R1 . R2
6.2.16.10.1.12	12	+00006	6.2.16.7.23	-YPIPAG	R1 . R2
6.2.16.10.1.13	13	+00007	6.2.16.7.26	-FBDX + .707ADSRAX	R2
6.2.16.10.1.14	14	+00008	6.2.16.7.26	.707 (-NBDZ- NEDY) + .5 (ADLAX-ADLAX) + .5 (ADSRAY + ADSRAZ)	R2
6.2.16.10.1.15	15	+00009	6.2.16.7.26	-NBDZ + .707ADSRAX	R2
6.2.16.10.1.16	16	+00010	6.2.16.7.26	.707(NBDY - NBDX) + .5 (ADLAX - ADLAX) + .5 ADSRAZ	R2

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6.2.16.10.2 Obtain data from last historical IRIG and PIPA test and complete Table X_{I-1}.

TABLE X_{I-1}

PARAMETER	UNITS	RECORDED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIAX	meru/g	
ADIAZ	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

6.2.16.10.3 Obtain data from the second last historical IRIG and PIPA test and complete Table X_{I-2}.

TABLE X_{I-2}

PARAMETER	UNITS	RECORDED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIAX	meru/g	

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6.2.16.10.2 Obtain data from last historical IRIG and PIPA test and complete Table X_{i-1}.

TABLE X_{i-1}

PARAMETER	UNITS	RECORDED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIAX	meru/g	
ADIAZ	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

6.2.16.10.3 Obtain data from the second last historical IRIG and PIPA test and complete Table X_{i-2}.

TABLE X_{i-2}

PARAMETER	UNITS	RECORDED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIAX	meru/g	

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TABLE X₁₋₂ (Continued)

PARAMETER	UNITS	RECORDED VALUE
ADIA Y	meru/g	
ADIA Z	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

6.2.16.10.4 Obtain data from the third last historical IRIG and PIPA test and complete Table X₁₋₃.

TABLE X₁₋₃

PARAMETER	UNITS	RECORDED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIA X	meru/g	
ADIA Y	meru/g	
ADIA Z	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

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TABLE X₁₋₂ (Continued)

PARAMETER	UNITS	RECORDED VALUE
ADIA Y	meru/g	
ADIA Z	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

6.2.16.10.4 Obtain data from the third last historical IRIG and PIPA test and complete Table X₁₋₃.

TABLE X₁₋₃

PARAMETER	UNITS	RECORDED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADLAX	meru/g	
ADLAY	meru/g	
ADLAZ	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

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6.2.16.10.5 Compute the PIPA Scale Factor error in parts per million and record in Table X.

$$a. \text{ PIPA S. F. Error} = \left[1.00000 - \frac{(2 \text{ local } g)}{+PIPAG - (-PIPAG)} \right] 10^6$$

$$b. \text{ X PIPA S. F. Error} = \left[1.000000 - \frac{(2 \text{ local } g)}{\text{line 2} - \text{line 4}} \right] 10^6$$

$$c. \text{ Y PIPA S. F. Error} = \left[1.000000 - \frac{(2 \text{ local } g)}{\text{line 11} - \text{line 12}} \right] 10^6$$

$$d. \text{ Z PIPA S. F. Error} = \left[1.000000 - \frac{(2 \text{ local } g)}{\text{line 7} - \text{line 9}} \right] 10^6$$

The PIPA S. F. Error shall not exceed ± 2000 PPM.

6.2.16.10.6 Compute the PIPA Bias in cm/sec^2 and record in Table X₁.

$$a. \text{ PIPA Bias} = \frac{+PIPAG + (-PIPAG)}{2} = \text{--- cm/sec}^2$$

$$b. \text{ X PIPA Bias} = \frac{\text{line 2} + \text{line 4}}{2} =$$

$$c. \text{ Y PIPA Bias} = \frac{\text{line 11} + \text{line 12}}{2} =$$

$$d. \text{ Z PIPA Bias} = \frac{\text{line 7} + \text{line 9}}{2} =$$

The PIPA Bias shall not exceed $\pm 2.28 \text{ cm/sec}^2$.

6.2.16.10.7 Calculate NBD, ADSRA, and ADIA and record in Table X₁.

$$a. \text{ NBDX} = -(\text{line 6}) =$$

$$\text{NBDY} = \text{line 1} =$$

$$\text{NBDZ} = \text{line 3} =$$

NBD shall not exceed ± 15 meru.

$$b. \text{ ADSRAX} = \frac{(\text{line 13} - \text{line 6})}{.707} =$$

$$\text{ADSRAY} = \text{line 8} - \text{line 1}$$

$$\text{ADSRAZ} = \frac{\text{line 15} + \text{line 3}}{.707}$$

ADSRA shall not exceed ± 40 meru/g.

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6.2.16.10.5 Compute the PIPA Scale Factor error in parts per million and record in Table X.

$$\begin{aligned} \text{a. PIPA S. F. Error} &= \left[\frac{1.00000 - \frac{(2 \text{ local } g)}{+PIPAG - (-PIPAG)}} \right] 10^6 \\ \text{b. X PIPA S. F. Error} &= \left[\frac{1.000000 - \frac{(2 \text{ local } g)}{\text{line 2} - \text{line 4}}} \right] 10^6 \\ \text{c. Y PIPA S. F. Error} &= \left[\frac{1.000000 - \frac{(2 \text{ local } g)}{\text{line 11} - \text{line 12}}} \right] 10^6 \\ \text{d. Z PIPA S. F. Error} &= \left[\frac{1.000000 - \frac{(2 \text{ local } g)}{\text{line 7} - \text{line 9}}} \right] 10^6 \end{aligned}$$

The PIPA S. F. Error shall not exceed ± 2000 PPM.

6.2.16.10.6 Compute the PIPA Bias in cm/sec^2 and record in Table X₁.

$$\begin{aligned} \text{a. PIPA Bias} &= \frac{+PIPAG + (-PIPAG)}{2} = \text{--- cm/sec}^2 \\ \text{b. X PIPA Bias} &= \frac{\text{line 2} + \text{line 4}}{2} = \\ \text{c. Y PIPA Bias} &= \frac{\text{line 11} + \text{line 12}}{2} = \\ \text{d. Z PIPA Bias} &= \frac{\text{line 7} + \text{line 9}}{2} = \end{aligned}$$

The PIPA Bias shall not exceed $\pm 2.28 \text{ cm/sec}^2$.

6.2.16.10.7 Calculate NBD, ADSRA, and ADIA and record in Table X₁.

$$\begin{aligned} \text{a. NBDX} &= -(\text{line 6}) = \\ \text{NBDY} &= \text{line 1} = \\ \text{NBDZ} &= \text{line 3} = \\ \text{NBD} &\text{ shall not exceed } \pm 15 \text{ meru.} \\ \text{b. ADSRAX} &= \frac{(\text{line 13} - \text{line 6})}{.707} = \\ \text{ADSRAY} &= \text{line 8} - \text{line 1} \\ \text{ADSRAZ} &= \frac{\text{line 15} + \text{line 3}}{.707} \end{aligned}$$

ADSRA shall not exceed $\pm 40 \text{ meru/g.}$

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c. ADIAX = line 5 - line 6

$$ADIA Y = \text{line 16} - \frac{.707 (\text{NBDY} - \text{NBDX})}{.5} (\text{ADSRAX} - \text{ADIA X})$$

ADIAZ = line 10 - line 3

ADIA shall not exceed ± 100 meru/g.

TABLE X₁

PARAMETER	UNITS	CALCULATED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAX	meru/g	
ADIA X	meru/g	
ADIA Y	meru/g	
ADIAZ	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

6.2.16.10.8 Perform the following calculations for each term in Table X₁, and record the results in Table D.

$$D_1 = |X_{i-1} - X_i|$$

$$D_2 = |X_{i-1} - X_i| + |X_{i-2} - X_{i-1}|$$

$$D_3 = |X_{i-3} - X_{i-2}| + |X_{i-2} - X_{i-1}| + |X_{i-1} - X_i|$$

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c. ADIAX = line 5 - line 6

ADIAI = line 16 - $\frac{.707 (NBDY - NBDX) - .5 (ADSRAX - ADIAX)}{.5}$

ADIAZ = line 10 - line 3

ADIA shall not exceed ± 100 meru/g.

TABLE X₁

PARAMETER	UNITS	CALCULATED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIAX	meru/g	
ADIAI	meru/g	
ADIAZ	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

6.2.16.10.8 Perform the following calculations for each term in Table X₁, and record the results in Table D.

$$D_1 = |X_{i-1} - X_i|$$

$$D_2 = |X_{i-1} - X_i| + |X_{i-2} - X_{i-1}|$$

$$D_3 = |X_{i-3} - X_{i-2}| + |X_{i-2} - X_{i-1}| + |X_{i-1} - X_i|$$

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X_1 = data point just obtained
 X_{i-1} = last historical data point
 X_{i-2} = second last historical data point
 X_{i-3} = third last historical data point

NOTE: D_1 calculations begin with the first data point after ISS Pre-Vib; D_2 calculations begin with the second data point after ISS Pre-Vib; D_3 calculations begin with the third data point after Pre-Vib.

TABLE D

PARAMETER	UNITS	D_1	MAX	D_2	MAX	D_3	MAX
NBDX	meru		6		9		11
NBDY	meru		6		9		11
NBDZ	meru		6		9		11
ADSRAX	meru/g		14		21		25
ADSRAY	meru/g		14		21		25
ADSRAZ	meru/g		14		21		25
ADIAx	meru/g		17		33		40
ADIAy	meru/g		17		33		40
ADIAz	meru/g		17		33		40
X PIPA S. F. Error	PPM		400		500		600
Y PIPA S. F. Error	PPM		400		500		600
Z PIPA S. F. Error	PPM		400		500		600
X PIPA Bias	cm/sec ²		0.5		0.7		0.9
Y PIPA Bias	cm/sec ²		0.5		0.7		0.9
Z PIPA Bias	cm/sec ²		0.5		0.7		0.9

6.2.16.10.9 Failure to meet the above criteria shall result in retest according to paragraph 5.4.2.

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X_1 = data point just obtained
 X_{1-1} = last historical data point
 X_{1-2} = second last historical data point
 X_{1-3} = third last historical data point

NOTE: D_1 calculations begin with the first data point after ISS Pre-Vib; D_2 calculations begin with the second data point after ISS Pre-Vib; D_3 calculations begin with the third data point after Pre-Vib.

TABLE D

PARAMETER	UNITS	D_1	MAX	D_2	MAX	D_3	MAX
NBDX	ineru		6		9		11
NBDY	meru		6		9		11
NBDZ	meru		6		9		11
ADSRAX	meru/g		14		21		25
ADSRAY	meru/g		14		21		25
ADSRZ	meru/g		14		21		25
ADIAx	meru/g		17		33		40
ADIAy	meru/g		17		33		40
ADIAz	meru/g		17		33		40
X PIPA S. F. Error	PPM		400		500		600
Y PIPA S. F. Error	PPM		400		500		600
Z PIPA S. F. Error	PPM		400		500		600
X PIPA Bias	cm/sec ²		0.5		0.7		0.9
Y PIPA Bias	cm/sec ²		0.5		0.7		0.9
Z PIPA Bias	cm/sec ²		0.5		0.7		0.9

6.2.16.10.9 Failure to meet the above criteria shall result in retest according to paragraph 5.4.2.

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6.2.16.7.6

Calculate Δ NBD, Δ ADSRA, and Δ ADIA by taking the differences between the respective NBD, ADSRA, and ADIA terms in 6.2.16.5 and 6.2.16.5.1.

- a. Δ NBDX = _____ meru
 Δ NBDY = _____ meru
 Δ NBDZ = _____ meru
- b. Δ ADSRAX = _____ meru
 Δ ADSRAY = _____ meru
 Δ ADSRAZ = _____ meru
- c. Δ ADIAX = _____ meru
 Δ ADIAY = _____ meru
 Δ ADIAZ = _____ meru

Δ NBD shall not exceed ± 5 meru.

Δ ADSRA shall not exceed ± 10 meru.

Δ ADIA shall not exceed ± 15 meru.

6.2.16.7.6.1

Evaluate results to determine IMU Performance Test passed or failed.

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6.2.16.7.6

Calculate Δ NBD, Δ ADSRA, and Δ ADIA by taking the differences between the respective NBD, ADSRA, and ADIA terms in 6.2.16.5 and 6.2.16.5.1.

- a. Δ NBDX = _____ meru
 Δ NBDY = _____ meru
 Δ NBDZ = _____ meru
- b. Δ ADSRAX = _____ meru
 Δ ADSRAY = _____ meru
 Δ ADSRAZ = _____ meru
- c. Δ ADIAX = _____ meru
 Δ ADIAY = _____ meru
 Δ ADIAZ = _____ meru

Δ NBD shall not exceed ± 5 meru.

Δ ADSRA shall not exceed ± 10 meru.

Δ ADIA shall not exceed ± 15 meru.

6.2.16.7.6.1

Evaluate results to determine IMU Performance Test passed or failed.

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6.2.17.1

SXT-NB-IMU Fine Alignment Test: Perform Test 6.2.17.1 before proceeding to Test 6.2.17.2.

6.2.17.1

Perform Master Initialization 6.2.5.3 before proceeding.

6.2.17.2

Prior to performing this test, the G&N Installation Qualification fixture shall be installed on the supporting fixture and adjusted to permit proper operation of the G&N optics. The azimuth supplied by the azimuth autotest (Optical Reference No. 1) shall be known to ± 30 minutes of arc.

NOTE: The G&N shall have had OPERATE power applied for a minimum of 1 hour. Set the G/N POWER-OPTICS switch to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0 \pm 3.0 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTIX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.

6.2.17.3

Enter VERB 01 NOUN 10 into K148. Press the ENTER pushbutton. Enter 00003 into K148. Press the ENTER pushbutton. Record AAAAA and the time of day.

6.2.17.4

Enter VERB 21 NOUN 02 into K148. Press the ENTER pushbutton. Enter 01300 into K148. Press the ENTER pushbutton. Enter AAAAA into K148. Press the ENTER pushbutton.

6.2.17.5

Enter VERB 06, NOUN 02 into K148. Press ENTER. Enter 01300 into K148. Press ENTER. Record R1 = BBBB.

6.2.17.6

Perform the following calculations:

a. $R1 (BBBB) \times 5.12 = CCCC.C$ (Hrs. in high order scaler channel 3)
3600

b. $23.3 - CCCC.C = DDDDD$ Hrs.

c. Add DDDDD to time of day recorded in step 1.

DO NOT enter any of the PIPA misalignment tests within -0.2 hours of the time of day calculated in step 6.2.17.6c. This is the time at which the high order scaler, channel 3, will overflow. If a PIPA misalignment test is being performed at this time, unacceptable test results will occur.

6.2.17.7

Enter the following sequence into the Lower Equipment Bay (LEB) DSKY.

a. VERB 41 NOUN 20 ENTER

b. +00000, ENTER

c. +00000, ENTER

d. +00000, ENTER

6.2.17.8

On the G&N Indicator Control Panel set the following switches to the position indicated.

a. TELESCOPE TRUNNION to SLAVE to SXT

b. CONTROLLER COUPLING to DIRECT

c. CONTROLLER SPEED to LO

d. OPTICS MODE TO MAN

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6.2.17.1

SXT-NB-IMU Fine Alignment Test: Perform Test 6.2.17.1 before proceeding.

6.2.17.1

Perform Master Initialization 6.2.5.3 before proceeding.

6.2.17.2

Prior to performing this test, the G&N Installation Qualification fixture shall be installed on the supporting fixture and adjusted to permit proper operation of the G&N optics. The azimuth supplied by the azimuth autoset (Optical Reference No. 1) shall be known to ± 30 minutes of arc.

NOTE: The G&N shall have had OPERATE power applied for a minimum of 1 hour. Set the G/N POWER-OPTICS switch to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $\pm 28.0 \pm 3.0$ VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTIX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.

6.2.17.3

Enter VERB 01 NOUN 10 into K148. Press the ENTER pushbutton. Enter 00003 into K148. Press the ENTER pushbutton. Record AAAAA and the time of day.

6.2.17.4

Enter VERB 21 NOUN 02 into K148. Press the ENTER pushbutton. Enter 01300 into K148. Press the ENTER pushbutton. Enter AAAAA into K148. Press the ENTER pushbutton.

6.2.17.5

Enter VERB 06, NOUN 02 into K148. Press ENTER. Enter 01300 into K148. Press ENTER. Record R1 = BBBB.

6.2.17.6

Perform the following calculations:

a. $\frac{R1 (BBBB) \times 5,12}{3600} = CCCC.C$ (Hrs. in high order scaler channel 3)

b. $23.3 - CCCC.C = DDDDD$ Hrs.

c. Add DDDDD to time of day recorded in step 1.

DO NOT enter any of the PIPA misalignment tests within -0.2 hours of the time of day calculated in step 6.2.17.6c. This is the time at which the high order scaler, channel 3, will overflow. If a PIPA misalignment test is being performed at this time, unacceptable test results will occur.

6.2.17.7

Enter the following sequence into the Lower Equipment Bay (LEB) DSKY.

- a. VERB 41 NOUN 20 ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.17.8

On the G&N Indicator Control Panel set the following switches to the position indicated.

- a. TELESCOPE TRUNNION to SLAVE to SXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to LO
- d. OPTICS MODE TO MAN

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6.2.17.9 Enter the following into the DSKY.

- a. VERB 01 NOUN 01, ENTER
- b. 00362, ENTER
- Record R1 = XXXXY

6.2.17.10 Enter the following into the DSKY

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table II and XXXX is that recorded in 6.2.17.9.

TABLE II

Y (From 6.2.17.9)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.17.11 Initiate the test by entering the following sequence into the LEB DSKY.

- a. VERB 57, ENTER
- b. 00003, ENTER

6.2.17.12 Observe VERB 06 NOUN 66 flashing on the DSKY. The following data is displayed in R1 and R2 on the DSKY.

- a. R1 = +13500
- b. R2 = +xx.xxx (Site Latitude from Table I)

TABLE I

Test Site	Latitude
NAA	+33.922
MILA	+28.516
MSC	+29.556

6.2.17.13 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If the value displayed is other than +13500 in R1 and the correct Site Latitude in R2, correct the data by entering the following sequence into the DSKY.

- a. VERB 21, ENTER
- b. +13500, ENTER
- c. VERB 22, ENTER
- d. +xx.xxx, ENTER (+xx.xxx = Site Latitude from Table I)
- e. VERB 33, ENTER

6.2.17.14 Observe VERB 21 NOUN 30 flashing on the DSKY. Enter the following sequence into the DSKY.

- a. +00001, ENTER (Position Number)
- b. +00000, ENTER
- c. +00001, ENTER

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6.2.17.9 Enter the following into the DSKY.

- a. VERB 01 NOUN 01, ENTER
 - b. 00362, ENTER
- Record R1 = XXXXY

6.2.17.10 Enter the following into the DSKY

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table II and XXXX is that recorded in 6.2.17.9.

TABLE II

Y (From 6.2.17.9)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.17.11 Initiate the test by entering the following sequence into the LEB DSKY.

- a. VERB 57, ENTER
- b. 00003, ENTER

6.2.17.12 Observe VERB 06 NOUN 66 flashing on the DSKY. The following data is displayed in R1 and R2 on the DSKY.

- a. R1 = +13500
- b. R2 = +xx.xxx (Site Latitude from Table I)

TABLE I

Test Site	Latitude
NAA	+33.922
MILA	+28.516
MSC	+29.556

6.2.17.13 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If the value displayed is other than +13500 in R1 and the correct Site Latitude in R2, correct the data by entering the following sequence into the DSKY.

- a. VERB 21, ENTER
- b. +13500, ENTER
- c. VERB 22, ENTER
- d. +xx.xxx, ENTER (+xx.xxx = Site Latitude from Table I)
- e. VERB 33, ENTER

6.2.17.14 Observe VERB 21 NOUN 30 flashing on the DSKY. Enter the following sequence into the DSKY.

- a. +00001, ENTER (Position Number)
- b. +00000, ENTER
- c. +00001, ENTER

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- 6.2.17.15 Observe VERB 06 NOUN 66 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Y_{NB} Azimuth)
 - R2 = ±xx.xxx (Y_{NB} Elevation)
 - R3 = 00001
- 6.2.17.16 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct Y_{NB} azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx ± 002.00 degrees, ENTER (Y_{NB} azimuth)
 - +xx.xxx ± 02.000 degrees, ENTER (Y_{NB} elevation)
 - VERB 33, ENTER
- 6.2.17.17 Observe VERB 06 NOUN 66 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Z_{NB} Azimuth)
 - R2 = ±xx.xxx (Z_{NB} Elevation)
 - R3 = 00002
- 6.2.17.18 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct Z_{NB} azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx ± 002.00 degrees, ENTER (Z_{NB} Azimuth)
 - +xx.xxx ± 02.000 degrees, ENTER (Z_{NB} elevation)
 - VERB 33, ENTER
- 6.2.17.19 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Target 1 Azimuth)
 - R2 = ±xx.xxx (Target 1 Elevation)
 - R3 = 00001
- 6.2.17.20 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct azimuth and elevation for Target 1, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx ± 000.10 degrees, ENTER (Target 1 Azimuth)
 - ±xx.xxx ± 00.010 degrees, ENTER (Target 1 Elevation)
 - VERB 33, ENTER
- 6.2.17.21 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Target 2 Azimuth)
 - R2 = ±xx.xxx (target 2 Elevation)
 - R3 = 00002

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- 6.2.17.15 Observe VERB 06 NOUN 66 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Y_{NB} Azimuth)
 - R2 = ±xx.xxx (Y_{NB} Elevation)
 - R3 = 00001
- 6.2.17.16 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct YNB azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx ± 002.00 degrees, ENTER (Y_{NB} azimuth)
 - +xx.xxx ± 02.000 degrees, ENTER (Y_{NB} elevation)
 - VERB 33, ENTER
- 6.2.17.17 Observe VERB 06 NOUN 66 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Z_{NB} Azimuth)
 - R2 = ±xx.xxx (Z_{NB} Elevation)
 - R3 = 00002
- 6.2.17.18 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct ZNB azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx ± 002.00 degrees, ENTER (Z_{NB} Azimuth)
 - +xx.xxx ± 02.000 degrees, ENTER (Z_{NB} elevation)
 - VERB 33, ENTER
- 6.2.17.19 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Target 1 Azimuth)
 - R2 = ±xx.xxx (Target 1 Elevation)
 - R3 = 00001
- 6.2.17.20 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct azimuth and elevation for Target 1, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx ± 000.10 degrees, ENTER (Target 1 Azimuth)
 - ±xx.xxx ± 00.010 degrees, ENTER (Target 1 Elevation)
 - VERB 33, ENTER
- 6.2.17.21 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Target 2 Azimuth)
 - R2 = ±xx.xxx (target 2 Elevation)
 - R3 = 00002

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- 6.2.17.22 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct azimuth and elevation for Target 2, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx±000.10 degrees, ENTER (Target 2 Azimuth)
 - ±xx.xxxx±00.010 degrees, ENTER (Target 2 Elevation)
 - VERB 33, ENTER
- 6.2.17.23 Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds and return the OPTICS MODE switch to MAN. When VERB 51 NOUN 30 flashes on the DSKY set the OPTICS MODE switch on the G&N Indicator Control Panel to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.
- 6.2.17.24 Using the Optics Hand Controller, align the SXT StLOS with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.25 When VERB 51 NOUN 30 flashes on the DSKY set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.
- 6.2.17.26 Using the Optics Hand Controller, align the SXT StLOS with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.27 Repeat steps 6.2.17.23 through 6.2.17.26.
- 6.2.17.28 In approximately 7 minutes VERB 06 NOUN 66 shall flash on the DSKY and the test results shall be displayed. R1 and R2 on the DSKY shall display the misalignment of one of the horizontal PIPA's in arc seconds (R1 = whole, R2 = fractional). Record R1 and R2. (See Table II for PIPA displayed).
- 6.2.17.29 Enter VERB 33 ENTER into the DSKY. When VERB 06 NOUN 66 flashes R1 and R2 on the DSKY shall display the misalignment of the second horizontal PIPA in arc seconds (R1 whole, R2 fractional). (See Table II for PIPA displayed.) Record R1 and R2.
- 6.2.17.30 Enter VERB 34 ENTER into the DSKY to terminate the test.
- 6.2.17.31 Repeat steps 6.2.17.11 through 6.2.17.27 substituting position No. 00002 in 6.2.17.14a.
- 6.2.17.32 Enter the following into the DSKY.
- VERB 36, ENTER
 - VERB 41 NOUN 20, ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER

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- 6.2.17.22 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct azimuth and elevation for Target 2, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx±000.10 degrees, ENTER (Target 2 Azimuth)
 - ±xx.xxx±00.010 degrees, ENTER (Target 2 Elevation)
 - VERB 33, ENTER
- 6.2.17.23 Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds and return the OPTICS MODE switch to MAN. When VERB 51 NOUN 30 flashes on the DSKY set the OPTICS MODE switch on the G&N Indicator Control Panel to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.
- 6.2.17.24 Using the Optics Hand Controller, align the SXT StLOS with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.25 When VERB 51 NOUN 30 flashes on the DSKY set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.
- 6.2.17.26 Using the Optics Hand Controller, align the SXT StLOS with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.27 Repeat steps 6.2.17.23 through 6.2.17.26.
- 6.2.17.28 In approximately 7 minutes VERB 06 NOUN 66 shall flash on the DSKY and the test results shall be displayed. R1 and R2 on the DSKY shall display the misalignment of one of the horizontal PIPA's in arc seconds (R1 = whole, R2 = fractional). Record R1 and R2. (See Table II for PIPA displayed).
- 6.2.17.29 Enter VERB 33 ENTER into the DSKY. When VERB 06 NOUN 66 flashes R1 and R2 on the DSKY shall display the misalignment of the second horizontal PIPA in arc seconds (R1 whole, R2 fractional). (See Table II for PIPA displayed.) Record R1 and R2.
- 6.2.17.30 Enter VERB 34 ENTER into the DSKY to terminate the test.
- 6.2.17.31 Repeat steps 6.2.17.11 through 6.2.17.27 substituting position No. 00002 in 6.2.17.14a.
- 6.2.17.32 Enter the following into the DSKY.
- VERB 36, ENTER
 - VERB 41 NOUN 20, ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER

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Table II. Display Conditions at Test Completion

Position	SM Orientation			6.2.17.28	6.2.17.29
	XSM	YSM	ZSM		
1	UP	SW	SE	Y PIPA about Z PIPA	Z PIPA about Y PIPA
2	SE	SW	DN	X PIPA about Y PIPA	Y PIPA about X PIPA
3*	SE	UP	SW	X PIPA about Z PIPA	Z PIPA about X PIPA

* Position 3 is not run in the Spacecraft because of GIMBAL LOCK considerations.

6.2.17.33 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.17.34 Calculations

- 6.2.17.34.1 a. YPIPA about Z misalignment = () R1, R2
 b. ZPIPA about Y misalignment = () R1, R2
 c. XPIPA about Y misalignment = () R1, R2
 d. YPIPA about X misalignment = () R1, R2

6.2.17.34.2 Enter the latest values from 6.2.16 IMU Performance Test.

- a. X PIPA bias = _____ cm/sec²
 b. Y PIPA bias = _____ cm/sec²
 c. Z PIPA bias = _____ cm/sec²
 d. $\theta_x = 210$ (X PIPA bias) = _____ arc sec.
 e. $\theta_y = 210$ (Y PIPA bias) = _____ arc sec.
 f. $\theta_z = 210$ (Z PIPA bias) = _____ arc sec.

- 6.2.17.34.3 a. Y PIPA about Z misalignment (Bias corrected) = 6.2.17.32.1a - θ_y = _____ arc sec.
 b. Z PIPA about Y misalignment (Bias corrected) = 6.2.17.32.1b - θ_z = _____ arc sec.
 c. X PIPA about Y misalignment (Bias corrected) = 6.2.17.32.1c - θ_x = _____ arc sec.
 d. Y PIPA about X misalignment (Bias corrected) = 6.2.17.32.1d - θ_y = _____ arc sec.

The PIPA misalignments, excluding PIPA bias, shall not exceed ± 150 arc seconds.

6.2.18 Gyrocompassing Test

NOTE: Perform Master Initialization 6.2.5.3 before proceeding.

- 6.2.18.1 Set the G/N POWER-OPTICS Switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $+28.0 \pm 3.0$ VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90° h (CG 1212) are not flashing on the CRT.

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Table II. Display Conditions at Test Completion

Position	SM Orientation				
	XSM	YSM	ZSM	6.2.17.28	6.2.17.29
1	UP	SW	SE	Y PIPA about Z PIPA	Z PIPA about Y PIPA
2	SE	SW	DN	X PIPA about Y PIPA	Y PIPA about X PIPA
3*	SE	UP	SW	X PIPA about Z PIPA	Z PIPA about X PIPA

* Position 3 is not run in the Spacecraft because of GIMBAL LOCK considerations.

6.2.17.33 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.17.34 Calculations

- 6.2.17.34.1 a. YPIPA about Z misalignment = () R1, R2
 b. ZPIPA about Y misalignment = () R1, R2
 c. XPIPA about Y misalignment = () R1, R2
 d. YPIPA about X misalignment = () R1, R2

6.2.17.34.2 Enter the latest values from 6.2.16 IMU Performance Test.

- a. X PIPA bias = _____ cm/sec²
 b. Y PIPA bias = _____ cm/sec²
 c. Z PIPA bias = _____ cm/sec²
 d. $\theta_x = 210$ (X PIPA bias) = _____ arc sec.
 e. $\theta_y = 210$ (Y PIPA bias) = _____ arc sec.
 f. $\theta_z = 210$ (Z PIPA bias) = _____ arc sec.

- 6.2.17.34.3 a. Y PIPA about Z misalignment (Bias corrected) = 6.2.17.32.1a - θ_y = _____ arc sec.
 b. Z PIPA about Y misalignment (Bias corrected) = 6.2.17.32.1b - θ_z = _____ arc sec.
 c. X PIPA about Y misalignment (Bias corrected) = 6.2.17.32.1c - θ_x = _____ arc sec.
 d. Y PIPA about X misalignment (Bias corrected) = 6.2.17.32.1d - θ_y = _____ arc sec.

The PIPA misalignments, excluding PIPA bias, shall not exceed ± 150 arc seconds.

6.2.18 Gyrocompassing Test

NOTE: Perform Master Initialization 6.2.5.3 before proceeding.

- 6.2.18.1 Set the G/N POWER-OPTICS Switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $+28.0 \pm 3.0$ VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90° h (CG 1212) are not flashing on the CRT.

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6.2.18.2 Enter the following into the DSKY.

- a. VERB 01 NOUN 01, ENTER
 - b. 00362, ENTER
- Record R1 = XXXXY

6.2.18.3 Enter the following into the DSKY.

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table II and XXXX is that recorded in 6.2.18.2.

Table II

Y (From 6.2.18.2)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.18.4 Enter the following sequence into the K-Start, pressing ENTER pushbutton after each entry.

- a. VERB 57, ENTER
- b. 00006, ENTER

6.2.18.5 System shall advance to Gyrocompass System Test and display 01 on the CRT program display.

6.2.18.6 On the CRT observe VERB 06, NOUN 61 flashing with some launch azimuth displayed in R1 = +xxx.xx.

6.2.18.6.1 If the azimuth displayed is correct proceed to 6.2.18.5; if not, perform the following sequence:

- a. VERB 21, Press ENTER pushbutton
- b. +xxx.xx, press ENTER pushbutton (Correct Launch Azimuth)

6.2.18.7 After verifying that the correct launch azimuth is displayed in R1 on the CRT, Enter VERB 33 on the K-START and push the ENTER pushbutton.

6.2.18.8 Observe VERB 06 NOUN 61 flashing on the CRT with the following displayed in R1 and R2.

- a. R1 = +xxx.xx, Nav. Base Azimuth (Z_{NB})
- b. R2 = +xx.xxx, Site Latitude

6.2.18.8.1 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence:

To correct R1:

- a. VERB 21, ENTER
- b. +xxx.xx±000.50 degrees, ENTER (Z_{NB} Azimuth)

To correct R2:

- a. Verb 22, ENTER
- b. +xx.xxx, ENTER (Correct Site Latitude from Table I)

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6.2.18.2 Enter the following into the DSKY.

- a. VERB 01 NOUN 01, ENTER
 - b. 00362, ENTER
- Record R1 = XXXXY

6.2.18.3 Enter the following into the DSKY.

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table II and XXXX is that recorded in 6.2.18.2.

Table II

Y (From 6.2.18.2)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.18.4 Enter the following sequence into the K-Start, pressing ENTER pushbutton after each entry.

- a. VERB 57, ENTER
- b. 00006, ENTER

6.2.18.5 System shall advance to Gyrocompass System Test and display 01 on the CRT program display.

6.2.18.6 On the CRT observe VERB 06, NOUN 61 flashing with some launch azimuth displayed in R1 = +xxx.xx.

6.2.18.6.1 If the azimuth displayed is correct proceed to 6.2.18.5; if not, perform the following sequence:

- a. VERB 21, Press ENTER pushbutton
- b. +xxx.xx, press ENTER pushbutton (Correct Launch Azimuth)

6.2.18.7 After verifying that the correct launch azimuth is displayed in R1 on the CRT, Enter VERB 33 on the K-START and push the ENTER pushbutton.

6.2.18.8 Observe VERB 06 NOUN 61 flashing on the CRT with the following displayed in R1 and R2.

- a. R1 = ±xxx.xx, Nav. Base Azimuth (Z_{NB})
- b. R2 = ±xx.xxx, Site Latitude

6.2.18.8.1 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence:

To correct R1:

- a. VERB 21, ENTER
- b. +xxx.xx±000.50 degrees, ENTER (Z_{NB} Azimuth)

To correct R2:

- a. Verb 22, ENTER
- b. ±xx.xxx, ENTER (Correct Site Latitude from Table I)

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- 6.2.18.9 After the correct data for R1 and R2 are verified enter VERB 33 into the K-Start. Press the ENTER pushbutton. On the CRT observe the PROGRAM display change to 05 after approximately 90 seconds. After approximately 15 minutes, observe the PROGRAM display change to 02.
- 6.2.18.10 After 120 minutes set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.11 Enter VERB 52 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT change to 03.
- 6.2.18.12 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 1 azimuth and elevation.
- R1 = +xxx.xx (Target 1 azimuth)
 - R2 = +00.000 (Target 1 elevation)
- 6.2.18.13 Verify the data appearing in R1 and R2 and if correct, proceed. If not correct, perform the following sequence.
- VERB 24, ENTER
 - +xxx.xx + 000.01, ENTER (Target 1 azimuth)
 - +00.000, ENTER (Target 1 elevation)
- 6.2.18.14 After the correct readings for R1 and R2 are verified, enter VERB 33 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.15 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 2 azimuth and elevation.
- R1 = +xxx.xx (Target 2 azimuth)
 - R2 = +00.000 (Target 2 elevation)
- 6.2.18.16 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence.
- VERB 24, ENTER
 - +xxx.xx + 000.01, ENTER (Target 2 azimuth)
 - +00.000, ENTER (Target 2 elevation)
- 6.2.18.17 After the correct readings for R1 and R2 are verified enter VERB 33 into the K-Start. Press the ENTER pushbutton.

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- 6.2.18.9 After the correct data for R1 and R2 are verified enter VERB 33 into the K-Start. Press the ENTER pushbutton. On the CRT observe the PROGRAM display change to 05 after approximately 90 seconds. After approximately 15 minutes, observe the PROGRAM display change to 02.
- 6.2.18.10 After 120 minutes set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.11 Enter VERB 52 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT change to 03.
- 6.2.18.12 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 1 azimuth and elevation.
- R1 = +xxx.xx (Target 1 azimuth)
 - R2 = +00.000 (Target 1 elevation)
- 6.2.18.13 Verify the data appearing in R1 and R2 and if correct, proceed. If not correct, perform the following sequence.
- VERB 24, ENTER
 - +xxx.xx + 000.01, ENTER (Target 1 azimuth)
 - +00.000, ENTER (Target 1 elevation)
- 6.2.18.14 After the correct readings for R1 and R2 are verified, enter VERB 33 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.15 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 2 azimuth and elevation.
- R1 = +xxx.xx (Target 2 azimuth)
 - R2 = +00.000 (Target 2 elevation)
- 6.2.18.16 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence.
- VERB 24, ENTER
 - +xxx.xx + 000.01, ENTER (Target 2 azimuth)
 - +00.000, ENTER (Target 2 elevation)
- 6.2.18.17 After the correct readings for R1 and R2 are verified enter VERB 33 into the K-Start. Press the ENTER pushbutton.

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- 6.2.18.18 On the G&N Indicator Control Panel set the OPTICS MODE switch to MAN and the CONTROLLER SPEED to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target 1.
- 6.2.18.19 Set the CONTROLLER SPEED switch on the G&N Indicator Control Panel to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 1 and press the MARK pushbutton. If satisfied that the MARK was good, proceed. If not satisfied with MARK, press the MARK REJECT pushbutton and repeat the step.
- 6.2.18.20 Set the CONTROLLER SPEED switch to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target 2.
- 6.2.18.21 Set the CONTROLLER SPEED switch to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 2 and press the MARK pushbutton. If satisfied that the MARK was good, press the ENTER pushbutton. If not satisfied, press the MARK REJECT pushbutton and repeat this step.
- 6.2.18.22 On the CRT observe the following data displayed:
- VERB 06 NOUN 60
 - R1 = +xx.xxx (X gyre elevation error, degrees)
 - R2 = +xx.xxx (Y gyre elevation error, degrees)
 - R3 = +xx.xxx (Z gyre azimuth error, degrees)
- Record R1, R2 and R3.
- 6.2.18.23 Enter VERB 34 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT and DSKY's indicators Q2. Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.24 Repeat steps 6.2.18.11 through 6.2.18.23 for the next hour at the following intervals.
- 15 minutes
 - 30 minutes
 - 45 minutes
 - 60 minutes

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- 6.2.18.18 On the G&N Indicator Control Panel set the OPTICS MODE switch to MAN and the CONTROLLER SPEED to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target 1.
- 6.2.18.19 Set the CONTROLLER SPEED switch on the G&N Indicator Control Panel to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 1 and press the MARK pushbutton. If satisfied that the MARK was good, proceed. If not satisfied with MARK, press the MARK REJECT pushbutton and repeat the step.
- 6.2.18.20 Set the CONTROLLER SPEED switch to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target 2.
- 6.2.18.21 Set the CONTROLLER SPEED switch to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 2 and press the MARK pushbutton. If satisfied that the MARK was good, press the ENTER pushbutton. If not satisfied, press the MARK REJECT pushbutton and repeat this step.
- 6.2.18.22 On the CRT observe the following data displayed:
- a. VERB 06 NOUN 60
 - b. R1 = \pm xx.xxx (X gyre elevation error, degrees)
 - c. R2 = \pm xx.xxx (Y gyre elevation error, degrees)
 - d. R3 = \pm xx.xxx (Z gyre azimuth error, degrees)
- Record R1, R2 and R3.
- 6.2.18.23 Enter VERB 34 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT and DSKY's indicates 02. Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.24 Repeat steps 6.2.18.11 through 6.2.18.23 for the next hour at the following intervals.
- a. 15 minutes
 - b. 30 minutes
 - c. 45 minutes
 - d. 60 minutes

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6.2.18.25 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

6.2.18.26 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start three times. Press the ENTER pushbutton after each entry. Set the G/N POWER-OPTICS Switch on the LEB Lighting Control Panel to OFF.

6.2.18.27 Data Sheet

Line	Step No.	Parameter	Recorded Value
	6.2.18.22		
1		X Gyre Elevation Error	+ <u>R.1</u> degrees
2		Y Gyre Elevation Error	+ <u>R.2</u> degrees
3		Z Gyre Azimuth Error	+ <u>R.3</u> degrees
	6.2.18.24.a		
4		X Gyre Elevation Error	+ <u>R.1</u> degrees
5		Y Gyre Elevation Error	+ <u>R.2</u> degrees
6		Z Gyre Azimuth Error	+ <u>R.3</u> degrees
	6.2.18.24.b		
7		X Gyre Elevation Error	+ <u>R.1</u> degrees
8		Y Gyre Elevation Error	+ <u>R.2</u> degrees
9		Z Gyre Azimuth Error	+ <u>R.3</u> degrees
	6.2.18.24.c		
10		X Gyre Elevation Error	+ <u>R.1</u> degrees
11		Y Gyre Elevation Error	+ <u>R.2</u> degrees
12		Z Gyre Azimuth Error	+ <u>R.3</u> degrees
	6.2.18.24.d		
13		X Gyre Elevation Error	+ <u>R.1</u> degrees
14		Y Gyre Elevation Error	+ <u>R.2</u> degrees
15		Z Gyre Azimuth Error	+ <u>R.3</u> degrees

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- 6.2.18.25 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.26 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start three times. Press the ENTER pushbutton after each entry. Set the G/N POWER-OPTICS Switch on the LEB Lighting Control Panel to OFF.
- 6.2.18.27 Data Sheet

Line	Step No.	Parameter	Recorded Value
	6.2.18.22		
1		X Gyre Elevation Error	+ <u>R1</u> degrees
2		Y Gyre Elevation Error	+ <u>R.2</u> degrees
3		Z Gyre Azimuth Error	+ <u>R.3</u> degrees
	6.2.18.24.a		
4		X Gyre Elevation Error	+ <u>R.1</u> degrees
5		Y Gyre Elevation Error	+ <u>R.2</u> degrees
6		Z Gyre Azimuth Error	+ <u>R.3</u> degrees
	6.2.18.24.b		
7		X Gyre Elevation Error	+ <u>R.1</u> degrees
8		Y Gyre Elevation Error	+ <u>R.2</u> degrees
9		Z Gyre Azimuth Error	+ <u>R.3</u> degrees
	6.2.18.24.c		
10		X Gyre Elevation Error	+ <u>R.1</u> degrees
11		Y Gyre Elevation Error	+ <u>R.2</u> degrees
12		Z Gyre Azimuth Error	+ <u>R.3</u> degrees
	6.2.18.24.d		
13		X Gyre Elevation Error	+ <u>R.1</u> degrees
14		Y Gyre Elevation Error	+ <u>R.2</u> degrees
15		Z Gyre Azimuth Error	+ <u>R.3</u> degrees

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6.2.18.28 Calculations Sheet

6.2.18.28.1 Record the most recent values of the following coefficients from 6.2.16, IMJ Performance Test.

- a. NBDX = () _____
- b. NBDY = () _____
- c. NBDZ = () _____
- d. ADIAZ = () _____
- e. ADSRAY = () _____

6.2.18.28.2 Perform the following calculations. (Cos λ functions are provided in Table I.)

- a. $D(\text{vert}) = \text{NBDZ} - \text{ADIAZ}$
 $D(\text{vert}) = ()$ _____ meters
- b. $D(\text{east}) = \frac{\text{Sin (Launch Azimuth)}}{\text{Cos (Launch Azimuth)}} \frac{\text{NBDX} + \text{NBDY} + \text{ADSRAY}}$
- c. $\phi(\text{vert}) = \frac{D(\text{vert}) \times 24.2 + D(\text{east}) \times 206.26981}{3600 (\text{Cos } \lambda)}$
 $\phi(\text{vert}) = ()$ _____ degrees

Table I

Location	Latitude λ	Cos λ
NAA	33.917	0.82985
MILA	28.516	0.87868
MSC	29.556	0.86993

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6.2.18.28 Calculations Sheet

6.2.18.28.1 Record the most recent values of the following coefficients from 6.2.16, IMJ Performance Test.

- a. NBDX = () _____
- b. NBDY = () _____
- c. NBDZ = () _____
- d. ADIAZ = () _____
- e. ADSRAY = () _____

6.2.18.28.2 Perform the following calculations. (Cos λ functions are provided in Table I.)

- a. $D(\text{vert}) = \text{NBDZ} - \text{ADIAZ}$
 $D(\text{vert}) = ()$ _____ mersu
- b. $D(\text{east}) = \frac{\text{Sin (Launch Azimuth)}}{\text{Cos (Launch Azimuth)}} \frac{\text{NBDX} + \text{NBDY} + \text{ADSRAY}}{\text{Cos } \lambda}$
- c. $\phi(\text{vert}) = \frac{D(\text{vert}) \times 24.2 + D(\text{east}) \times 206.26981}{3600 (\text{Cos } \lambda)}$
 $\phi(\text{vert}) = ()$ _____ degrees

Table I

Location	Latitude λ	Cos λ
NAA	33.917	0.82985
MILA	28.516	0.87868
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6.2.18.28.3

Perform the following calculations using the recorded data from 6.2.18.27 and 6.2.18.28.2.

- a. Z Gyre azimuth error 2 hrs (corrected) = line 3 - ϕ (vert)
- b. Z Gyre azimuth error 2 hrs (corrected) = _____
Corrected Z Gyre azimuth error (corrected) shall be 0.00 ± 0.57 degrees
- b. X Gyre elevation error (2 hr) = line 1
X Gyre elevation error (2 hr) = _____ degrees
- c. Y Gyre elevation error (2 hr) = line 2
Y Gyre elevation error (2 hr) = _____ degrees
The X and Y Gyre elevation errors shall be 0.00 ± 0.05 degrees.
- d. Δ Z Gyre azimuth error (3 hr) = line 3 - line 15
 Δ Z Gyre azimuth error (3 hr) = _____ degrees
 Δ Z Gyre azimuth error shall be 0.00 ± 0.06 degrees.
- e. Δ X Gyre elevation error (3 hr) = line 1 - line 13
 Δ X Gyre elevation error (3 hr) = _____ degrees
- f. Δ Y Gyre elevation error (3 hr) = line 2 - line 14
 Δ Y Gyre elevation error (3 hr) = _____ degrees
 Δ X and Δ Y Gyre elevation error shall be 0.00 ± 0.03 degrees.

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6.2.18.28.3

Perform the following calculations using the recorded data from 6.2.18.27 and 6.2.18.28.2.

- a. Z Gyre azimuth error 2 hrs (corrected) = line 3 - ϕ (vert)
- b. Z Gyre azimuth error 2 hrs (corrected) = _____
Corrected Z Gyre azimuth error (corrected) shall be 0.00 \pm 0.57 degrees
- b. X Gyre elevation error (2 hr) = line 1
X Gyre elevation error (2 hr) = _____ degrees
- c. Y Gyre elevation error (2 hr) = line 2
Y Gyre elevation error (2 hr) = _____ degrees
The X and Y Gyre elevation errors shall be 0.00 \pm 0.08 degrees.
- d. Δ Z Gyre azimuth error (3 hr) = line 3 - line 15
 Δ Z Gyre azimuth error (3 hr) = _____ degrees
 Δ Z Gyre azimuth error shall be 0.00 \pm 0.06 degrees.
- e. Δ X Gyre elevation error (3 hr) = line 1 - line 13
 Δ X Gyre elevation error (3 hr) = _____ degrees
- f. Δ Y Gyre elevation error (3 hr) = line 2 - line 14
 Δ Y Gyre elevation error (3 hr) = _____ degrees
 Δ X and Δ Y Gyre elevation error shall be 0.00 \pm 0.03 degrees.

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6.2.19 CMC Voltage Margin Test

6.2.19.1 Verify that the G&N IMU HTR MNA and MNB breakers are engaged, computer MNA and MNB breakers are engaged, IMU MNA and MNB breakers are not engaged, and the G&N Power-IMU switch on the LEB Lighting Control Panel is in the OFF position.

6.2.19.2 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to ON.

Caution: During the performance of this test the +4 VDC CMC Power Supply shall not be operated at less than +2.5 VDC or greater than 5.2 VDC (CG 1030). The +14 VDC CMC Power Supply shall not be operated at less than +8.5 VDC or greater than +17.0 VDC (CG 1020).

Note: The flashing indication of the CMC Power Supplies on CRT may be disregarded for this test. The charts in Table I may be used to determine approximate values for the "XX.X" values of C-156 voltage dial settings corresponding to various power supply voltages.

6.2.19.3 Units R-154 insert 0111. Verify and execute.

6.2.19.4 Insert in C-156 + XX.X001244 (Enter a value for XX.X which will adjust the +14 VDC Power Supply (CG1020) to 12.1 (+0.3, -0.0) VDC). Execute. Verify CG1020 on the CRT.

6.2.19.5 Insert in C-156 + XX.X001234 (Enter a value for XX.X which will adjust the +4 VDC Power Supply (CG1030) to 3.5 (+0.15, -0.0) VDC). Execute. Verify CG1030 on the CRT.

6.2.19.6 On K-148 press ERROR RESET

6.2.19.7 Initiate CMC Self-Check by inserting the following into K-148.

a. VERB 21 NOUN 27, ENTER

b. TTTTT, ENTER

Wait 200 seconds. Verify RESTART lamp on DSKY is not lighted.

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6.2.19 CMC Voltage Margin Test

6.2.19.1 Verify that the G&N IMU HTR MNA and MNB breakers are engaged, computer MNA and MNB breakers are engaged, IMU MNA and MNB breakers are not engaged, and the G&N Power-IMU switch on the LEB Lighting Control Panel is in the OFF position.

6.2.19.2 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to ON.

Caution: During the performance of this test the +4 VDC CMC Power Supply shall not be operated at less than +2.5 VDC or greater than 5.2 VDC (CG1030). The +14 VDC CMC Power Supply shall not be operated at less than +8.5 VDC or greater than +17.0 VDC (CG1020).

Note: The flashing indication of the CMC Power Supplies on CRT may be disregarded for this test. The charts in Table I may be used to determine approximate values for the "XX.X" values of C-156 voltage dial settings corresponding to various power supply voltages.

6.2.19.3 Units R-154 insert 0111. Verify and execute.

6.2.19.4 Insert in C-156 + XX.X001244 (Enter a value for XX.X which will adjust the +14 VDC Power Supply (CG1020) to 12.1 (+0.3, -0.0) VDC). Execute. Verify CG1020 on the CRT.

6.2.19.5 Insert in C-156 + XX.X001234 (Enter a value for XX.X which will adjust the +4 VDC Power Supply (CG1030) to 3.5 (+0.15, -0.0) VDC). Execute. Verify CG1030 on the CRT.

6.2.19.6 On K-148 press ERROR RESET

6.2.19.7 Initiate CMC Self-Check by inserting the following into K-148.

- a. VERB 21 NOUN 27, ENTER
- b. 77777, ENTER

Wait 200 seconds. Verify RESTART lamp on DSKY is not lighted.

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- 6.2.19.8 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on DSKY is lighted.
- 6.2.19.9 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to ON. Press ERROR RESET. Insert into K-148:
- a. VERB 21, NOUN 27, ENTER
- b. TTTT77, ENTER
- 6.2.19.10 Insert into C-156 + XX.X001244 (Enter a value for XX.X which will adjust the +14 VDC CMC Power Supply (CG1020) to +16.4 (0.0, -0.4) VDC). Execute. Verify CG1020 on the CRT.
- 6.2.19.11 Press ERROR RESET on K-148. Wait 200 seconds. Verify RESTART lamp on DSKY is not lighted.
- 6.2.19.12 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to off. Verify RESTART lamp on the DSKY is lighted. Set the INHIBIT VOLTAGE FAIL switch to ON. Press ERROR RESET. Insert into K-148.
- a. VERB 21 NOUN 27, ENTER
- b. TTTT77, ENTER
- 6.2.19.13 Insert into C-156 + XX.X001234 (Enter a value for XX.X which will adjust the +4 VDC CMC Power Supply (CG1030) to 4.6 (+0.0, -0.2) VDC). Execute. Verify CG1030 on the CRT.
- 6.2.19.14 Press ERROR RESET on K-148. Wait 200 seconds. Verify RESTART lamp on DSKY is not lighted
- 6.2.19.15 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on the DSKY is lighted. Set the INHIBIT VOLTAGE FAIL switch to on. Press ERROR RESET. Insert into K-148.
- a. VERB 21 NOUN 27, ENTER
- b. TTTT77, ENTER
- 6.2.19.16 Insert into C-156 + XX.X001244 (Enter a value for XX.X which will adjust the +14 VDC CMC Power Supply (CG1020) to 12.1 (+0.3, -0.0) VDC). Execute. Verify CG1020 on the CRT.

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- 6.2.19.8 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on DSKY is lighted.
- 6.2.19.9 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to ON. Press ERROR RESET. Insert into K-148:
- a. VERB 21, NOUN 27, ENTER
b. 77777, ENTER
- 6.2.19.10 Insert into C-156 + XX.X001244 (Enter a value for XX.X which will adjust the +14 VDC CMC. Power Supply (CG1020) to +16.4 (0.0, -0.4) VDC). Execute. Verify CG1020 on the CRT.
- 6.2.19.11 Press ERROR RESET on K-148. Wait 200 seconds. Verify RESTART lamp on DSKY is not lighted.
- 6.2.19.12 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to off. Verify RESTART lamp on the DSKY is lighted. Set the INHIBIT VOLTAGE FAIL switch to ON. Press ERROR RESET. Insert into K-148.
- a. VERB 21 NOUN 27, ENTER
b. 77777, ENTER
- 6.2.19.13 Insert into C-156 + XX.X001234 (Enter a value for XX.X which will adjust the +4 VDC CMC Power Supply (CG1030) to 4.5 (+0.0, -0.2) VDC). Execute. Verify CG1030 on the CRT.
- 6.2.19.14 Press ERROR RESET on K-148. Wait 200 seconds. Verify RESTART lamp on DSKY is not lighted
- 6.2.19.15 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on the DSKY is lighted. Set the INHIBIT VOLTAGE FAIL switch to on. Press ERROR RESET. Insert into K-148.
- a. VERB 21 NOUN 27, ENTER
b. 77777, ENTER
- 6.2.19.16 Insert into C-156 + XX.X001244 (Enter a value for XX.X which will adjust the +14 VDC CMC Power Supply (CG1020) to 12.1 (+0.3, -0.0) VDC). Execute. Verify CG1020 on the CRT.

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6.2.19.17 Press ERROR RESET on K-148. Wait 200 seconds. Verify RESTART lamp on the DSKY is not lighted.

6.2.19.18 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on the DSKY is lighted.

6.2.19.19 Into R-154 insert 0000. Verify and execute.

6.2.19.20 Terminate the OMC Self-Check by inserting into K-148:

a. VERB 21 NOUN 27, ENTER

b. 00000, ENTER

Press ERROR RESET on K-148.

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- 6.2.19.17 Press ERROR RESET on K-148. Wait 200 seconds. Verify RESTART lamp on the DSKY is not lighted.
- 6.2.19.18 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on the DSKY is lighted.
- 6.2.19.19 Into R-154 insert 0000. Verify and execute.
- 6.2.19.20 Terminate the CMC Self-Check by inserting into K-148:
- a. VERB 21 NOUN 27, ENTER
 - b. 00000, ENTER

Press ERROR RESET on K-148.

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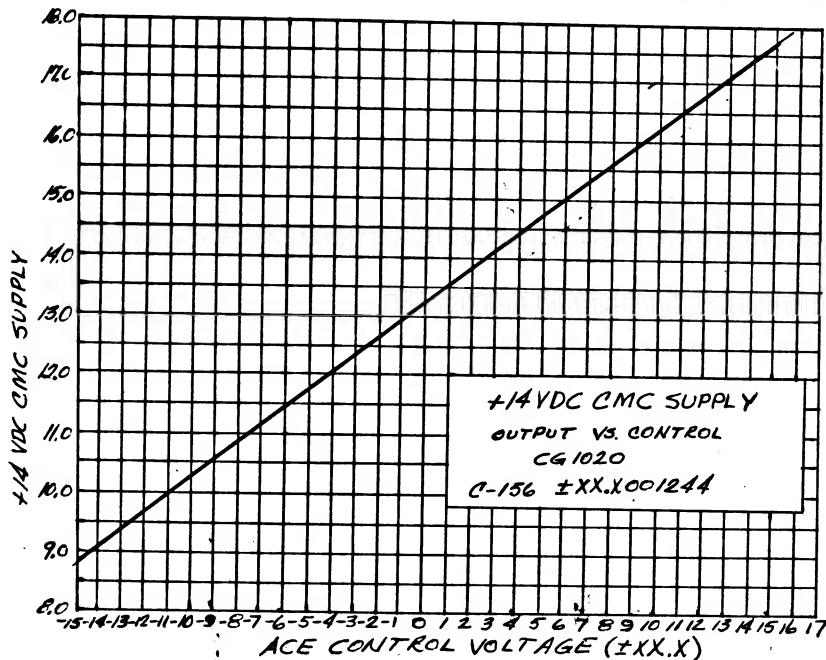
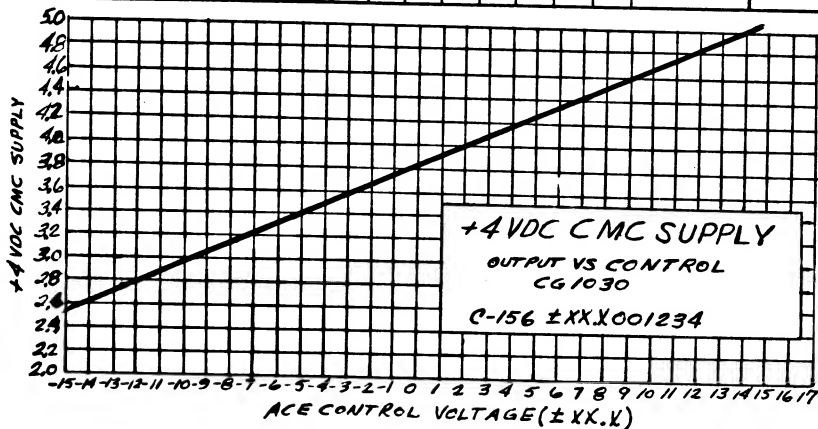


TABLE I

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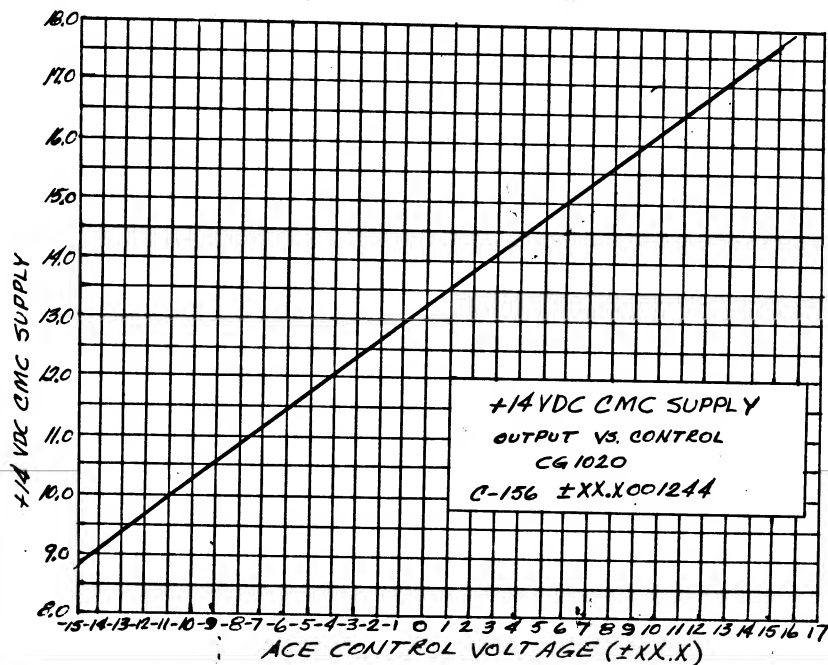
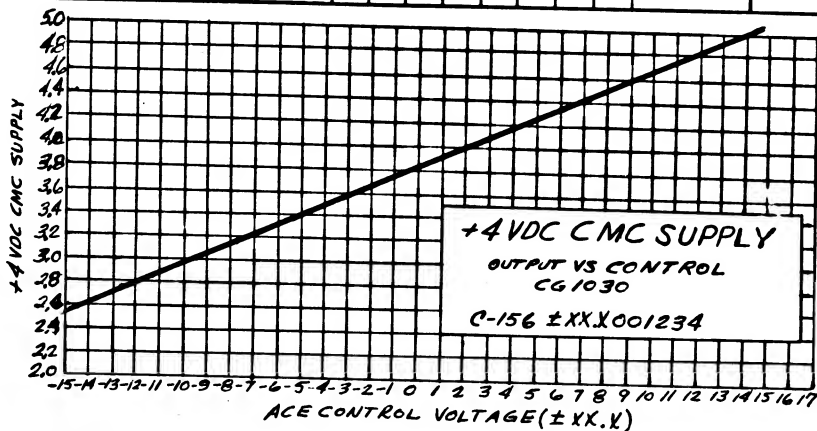


TABLE I

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6.2.21 Spacecraft Control and Displays Test

6.2.21.1 Perform Master Initialization before proceeding. If system operation.

6.2.21.2 Perform Master Initialization before proceeding. If system operation.

6.2.21.2 FDAI Attitude Error

6.2.21.2.1 Insert in K148

- a. V 57 ENTER
- b. 00013 ENTER

6.2.21.2.2 Observe on CRT

- a. V 06 NO1 Flashing
- b. PROG 07
- c. NO ATT ON
- d. R1, R2, and R3 Approx. 00000

6.2.21.2.3 Insert in K148

- a. VERB 33, ENTER

6.2.21.2.4 Observe on CRT

- a. V 06 NO1 Flashing
- b. R1 +00385
- c. R2 -00385
- d. R3 +00385
- e. NO ATT OFF

6.2.21.2.5 Record CRT indications

- a. CG 2279 ROLL ATT ERROR - CDU DAC OUT +16.88 ± 1.65 degrees
- b. CG 2219 PITCH ATT ERROR - CDU DAC OUT -16.88 ± 1.65 degrees
- c. CG 2249 YAW ATT ERROR - CDU DAC OUT +16.88 ± 1.65 degrees

6.2.21.2.6 Insert in K148

- a. VERB 33, ENTER

6.2.21.2.7 Observe on CRT

- a. V 06 NO1 Flashing
- b. R1 +00384
- c. R2 -00384
- d. R3 +00384

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a. V 06	N01	Flashing
b. R1	+00384	
c. R2	-00384	
d. R3	+00384	

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6.2.21.2.8 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	+16.88 ±1.65 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	+16.88 ±1.65 degrees

6.2.21.2.9 Insert in K148

a. VERB 33, ENTER

6.2.21.2.10 Observe on CRT

a. V 06	N01	Flashing
b. R1		+00160
c. R2		-00160
d. R3		+00160

6.2.21.2.11 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	+6.95 ±0.69 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	-6.95 ±0.69 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	+6.95 ±0.69 degrees

6.2.21.2.12 Insert in K148

a. VERB 33, ENTER

6.2.21.2.13 Observe on CRT

a. V 06	N01	Flashing
b. R1		+00135
c. R2		-00135
d. R3		+00135

6.2.21.2.14 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	+5.88 ±0.59 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	-5.88 ±0.59 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	+5.88 ±0.59 degrees

6.2.21.2.15 Insert in K148

a. VERB 33, ENTER

6.2.21.2.16 Observe on CRT

a. V 06	N01	Flashing
b. R1		+00090
c. R2		-00090
d. R3		+00090

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6.2.21.2.8 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	+16.88 ±1.65 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	+16.88 ±1.65 degrees

6.2.21.2.9 Insert in K148

a. VERB 33, ENTER

6.2.21.2.10 Observe on CRT

a. V 06	NO1	Flashing
b. R1		+00160
c. R2		-00160
d. R3		+00160

6.2.21.2.11 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	+6.95 ±0.69 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	-6.95 ±0.69 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	+6.95 ±0.69 degrees

6.2.21.2.12 Insert in K148

a. VERB 33, ENTER

6.2.21.2.13 Observe on CRT

a. V 06	NO1	Flashing
b. R1		+00135
c. R2		-00135
d. R3		+00135

6.2.21.2.14 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	+5.88 ±0.59 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	-5.88 ±0.59 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	+5.88 ±0.59 degrees

6.2.21.2.15 Insert in K148

a. VERB 33, ENTER

6.2.21.2.16 Observe on CRT

a. V 06	NO1	Flashing
b. R1		+00090
c. R2		-00090
d. R3		+00090

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6.2.21.2.17 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	+3.93 ±0.39 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	-3.93 ±0.39 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	+3.93 ±0.39 degrees

6.2.21.2.18 Insert in KI48

a. VERB 33, ENTER

6.2.21.2.19 Observe on CRT

a. V 06	NO1	Flashing
b. R1		+00000
c. R2		+00000
d. R3		-00090

6.2.21.2.20 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	0.00 ±0.19 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	0.00 ±0.19 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-3.93 ±0.39 degrees

6.2.21.2.21 Insert in KI48

a. VERB 33, ENTER

6.2.21.2.22 Observe on CRT

a. V 06	NO1	Flashing
b. R1		-00090
c. R2		+00090
d. R3		-00135

6.2.21.2.23 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-3.93 ±0.39 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+3.93 ±0.39 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-5.86 ±0.59 degrees

6.2.21.2.24 Insert in KI48

a. VERB 33, ENTER

6.2.21.2.25 Observe on CRT

a. V 06	NO1	Flashing
b. R1		-00135
c. R2		+00135
d. R3		-00160

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6.2.21.2.17 Record CRT indications

- | | | |
|------------|-------------------------------|---------------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | +3.93 ±0.39 degrees |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | -3.93 ±0.39 degrees |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | +3.93 ±0.39 degrees |

6.2.21.2.18 Insert in K148

- a. VERB 33, ENTER

6.2.21.2.19 Observe on CRT

- | | | |
|---------|-----|----------|
| a. V 06 | N01 | Flashing |
| b. R1 | | +00000 |
| c. R2 | | +00000 |
| d. R3 | | -00090 |

6.2.21.2.20 Record CRT indications

- | | | |
|------------|-------------------------------|---------------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | 0.00 ±0.19 degrees |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | 0.00 ±0.19 degrees |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | -3.93 ±0.39 degrees |

6.2.21.2.21 Insert in K148

- a. VERB 33, ENTER

6.2.21.2.22 Observe on CRT

- | | | |
|---------|-----|----------|
| a. V 06 | N01 | Flashing |
| b. R1 | | -00090 |
| c. R2 | | +00090 |
| d. R3 | | -00135 |

6.2.21.2.23 Record CRT indications

- | | | |
|------------|-------------------------------|---------------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | -3.93 ±0.39 degrees |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +3.93 ±0.39 degrees |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | -5.88 ±0.59 degrees |

6.2.21.2.24 Insert in K148

- a. VERB 33, ENTER

6.2.21.2.25 Observe on CRT

- | | | |
|---------|-----|----------|
| a. V 06 | N01 | Flashing |
| b. R1 | | -00135 |
| c. R2 | | +00135 |
| d. R3 | | -00160 |

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6.2.21.2.26 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-5.88 ±0.59 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+5.88 ±0.59 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-6.95 ±0.69 degrees

6.2.21.2.27 Insert in K148

a. VERB 33, ENTER

6.2.21.2.28 Observe on CRT

a. V 06	N01	Flashing
b. R1		-00160
c. R2		+00160
d. R3		-00384

6.2.21.2.29 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-6.95 ±0.69 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+6.95 ±0.69 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees

6.2.21.2.30 Insert in K148

a. VERB 33, ENTER

6.2.21.2.31 Observe on CRT

a. V 06	N01	Flashing
b. R1		-00384
c. R2		+00384
d. R3		-00385

6.2.21.2.32 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+16.88 ±1.65 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees

6.2.21.2.33 Insert in K148

a. VERB 33, ENTER

6.2.21.2.34 Observe on CRT

a. V 06	N01	Flashing
b. R1		-00385
c. R2		+00385
d. R3		+00000

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6.2.21.2.26 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-5.88 ±0.59 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+5.88 ±0.59 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-6.95 ±0.69 degrees

6.2.21.2.27 Insert in K148

a. VERB 33, ENTER

6.2.21.2.28 Observe on CRT

a. V 06	N01	Flashing
b. R1		-00160
c. R2		+00160
d. R3		-00384

6.2.21.2.29 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-6.95 ±0.69 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+6.95 ±0.69 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees

6.2.21.2.30 Insert in K148

a. VERB 33, ENTER

6.2.21.2.31 Observe on CRT

a. V 06	N01	Flashing
b. R1		-00384
c. R2		+00384
d. R3		-00385

6.2.21.2.32 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+16.88 ±1.65 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees

6.2.21.2.33 Insert in K148

a. VERB 33, ENTER

6.2.21.2.34 Observe on CRT

a. V 06	N01	Flashing
b. R1		-00385
c. R2		+00385
d. R3		+00000

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6.2.21.2.35 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+16.88 ±1.65 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	0.00 ±0.19 degrees

6.2.21.2.36 Insert in K148

a. V 21	N01	ENTER
b. 02545		ENTER
c. 03302		ENTER
d. V 33		ENTER

6.2.21.2.37 Observe on CRT

a. V 06	N03	Flashing
b. NO ATT		ON
c. R1		+00000 approximately
d. R2		+00000 approximately
e. R3		+00000 approximately

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6.2.21.2.35 Record CRT indications

- | | | |
|------------|-------------------------------|----------------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | -16.88 ±1.65 degrees |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +16.88 ±1.65 degrees |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | 0.00 ±0.19 degrees |

6.2.21.2.36 Insert in K148

- | | | |
|----------|-----|-------|
| a. V 21 | NO1 | ENTER |
| b. 02545 | | ENTER |
| c. 03302 | | ENTER |
| d. V 33 | | ENTER |

6.2.21.2.37 Observe on CRT

- | | | |
|-----------|-----|----------------------|
| a. V 96 | NO3 | Flashing |
| b. NO ATT | | ON |
| c. R1 | | +00000 approximately |
| d. R2 | | +00000 approximately |
| e. R3 | | +00000 approximately |

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- 6.2.21.3 TVC Test
- 6.2.21.3.1 The G/N Autopilot Control and SPS Ready discretes shall be applied to the G/N interface.
- 6.2.21.3.2 Set the OPTICS MODE selector on the Indicator Control panel to MAN.
- 6.2.21.3.3 Insert in K148
- a. VERB 33, ENTER
- 6.2.21.3.4 Observe on CRT
- | | | |
|---------|------|----------|
| a. V 01 | N 10 | Flashing |
| b. R1 | | X7373 |
| c. R3 | | 00030 |
- 6.2.21.3.5 Insert in K148
- a. V 33 ENTER
- 6.2.21.3.6 Observe on CRT
- | | | |
|---------|---------|----------|
| a. V 01 | NOUN 10 | Flashing |
| b. R1 | | 37777 |
| c. R3 | | 00031 |
- 6.2.21.3.7 Insert in K148
- a. V 33 ENTER
- 6.2.21.3.8 Observe on CRT
- | | | |
|---------|------|----------|
| a. V 06 | N 03 | Flashing |
| b. R1 | | +00385 |
| c. R2 | | -00385 |
| d. R3 | | +00003 |
- 6.2.2.3.9 Record CRT indications
- | | | |
|------------|-------------------------|----------------------|
| a. CG 3722 | TRUNNION CDU DAC OUTPUT | +16.88 ±1.00 degrees |
| b. CG 3721 | SHAFT CDU DAC OUTPUT | -16.88 ±1.00 degrees |
- 6.2.21.3.10 Insert in K148
- a. VERB 33, ENTER

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6.2.21.3 TVC Test

6.2.21.3.1 The G/N Autopilot Control and SPS Ready discretes shall be applied to the G/N interface.

6.2.21.3.2 Set the OPTICS MODE selector on the Indicator Control panel to MAN.

6.2.21.3.3 Insert in K148

a. VERB 33, ENTER

6.2.21.3.4 Observe on CRT

a. V 01	N 10	Flashing
b. R1		X7373
c. R3		00030

6.2.21.3.5 Insert in K148

a. V 33 ENTER

6.2.21.3.6 Observe on CRT

a. V 01	NOUN 10	Flashing
b. R1		37777
c. R3		00031

6.2.21.3.7 Insert in K148

a. V 33 ENTER

6.2.21.3.8 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00385
c. R2		-00385
d. R3		+00003

6.2.2.3.9 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+16.88 ±1.00 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-16.88 ±1.00 degrees

6.2.21.3.10 Insert in K148

a. VERB 33, ENTER

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6.2.21.3.11 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00384
c. R2		-00384
d. R3		+00003
e. NO ATT		OFF

6.2.21.3.12 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+16.88 ±1.00 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-16.88 ±1.00 degrees

6.2.21.3.13 Insert in K148

a. VERB 33, ENTER

6.2.21.3.14 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00160
c. R2		-00160
d. R3		+00003

6.2.21.3.15 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+6.95 ±0.41 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-6.95 ±0.41 degrees

6.2.21.3.16 Insert in K148

a. VERB 33, ENTER

6.2.21.3.17 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00135
c. R2		-00135
d. R3		+00003

6.2.21.3.18 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+5.88 ±0.35 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-5.88 ±0.35 degrees

6.2.21.3.19 Insert in K148

a. VERB 33, ENTER

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6.2.21.3.11 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00384
c. R2		-00384
d. R3		+00003
e. NO ATT		OFF

6.2.21.3.12 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+16.88 ±1.00 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-16.88 ±1.00 degrees

6.2.21.3.13 Insert in K148

a. VERB 33, ENTER

6.2.21.3.14 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00160
c. R2		-00160
d. R3		+00003

6.2.21.3.15 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+6.95 ±0.41 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-6.95 ±0.41 degrees

6.2.21.3.16 Insert in K148

a. VERB 33, ENTER

6.2.21.3.17 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00135
c. R2		-00135
d. R3		+00003

6.2.21.3.18 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+5.88 ±0.35 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-5.88 ±0.35 degrees

6.2.21.3.19 Insert in K148

a. VERB 33, ENTER

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6.2.21.3.20 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00090
c. R2		-00090
d. R3		+00003

6.2.21.3.21 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+3.93 ±0.24 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-3.93 ±0.24 degrees

6.2.21.3.22 Set the OPTICS CONTROLLER SPEED Switch on the Indicator Control panel to HI.

6.2.21.3.23 Insert in K148

a. VERB 33, ENTER

6.2.21.3.24 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00000
c. R2		+00000
d. R3		+00003

6.2.21.3.25 While holding the Optics Hand Controller up and left (45°) no longer than 10 seconds, record CRT indications.

a. CG 3722	TRUNNION CDU DAC OUTPUT	0.00 ±0.19 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	0.00 ±0.19 degrees

6.2.21.3.26 Insert in K148

a. VERB 33, ENTER

6.2.21.3.27 Observe on CRT

a. V 06	N 03	Flashing
b. R1		-00090
c. R2		+00090
d. R3		+00003

6.2.21.3.28 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-3.93 ± .24 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	+3.93 ± .24 degrees

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6.2.21.3.20 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00090
c. R2		-00090
d. R3		+00003

6.2.21.3.21 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+3.93 ±0.24 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-3.93 ±0.24 degrees

6.2.21.3.22 Set the OPTICS CONTROLLER SPEED Switch on the Indicator Control panel to HI.

6.2.21.3.23 Insert in K148

a. VERB 33, ENTER

6.2.21.3.24 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00000
c. R2		+00000
d. R3		+00003

6.2.21.3.25 While holding the Optics Hand Controller up and left (45°) no longer than 10 seconds, record CRT indications.

a. CG 3722	TRUNNION CDU DAC OUTPUT	0.00 ±0.19 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	0.00 ±0.19 degrees

6.2.21.3.26 Insert in K148

a. VERB 33, ENTER

6.2.21.3.27 Observe on CRT

a. V 06	N 03	Flashing
b. R1		-00090
c. R2		+00090
d. R3		+00003

6.2.21.3.28 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-3.93 ± .24 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	+3.93 ± .24 degrees

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6.2.21.3.29 Set the OPTICS MODE Switch on the Indicator Control panel to ZERO for 30 seconds, then return to MAN.

6.2.21.3.30 Insert in K148

a. VERB 33, ENTER

6.2.21.3.31 Observe on CRT

a. V 06	N 03	Flashing
b. R1		-00135
c. R2		+00135
d. R3		+00003

6.2.21.3.32 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-5.88 ±0.35 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	+5.88 ±0.35 degrees

6.2.21.3.33 Insert in K148

a. VERB 33, ENTER

6.2.21.3.34 Observe on CRT

a. V 06	N 03	Flashing
b. R1		-00160
c. R2		+00160
d. R3		+00003

6.2.21.3.35 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-6.95 ±0.41 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	+6.95 ±0.41 degrees

6.2.21.3.36 Insert in K148

a. VERB 33, ENTER

6.2.21.3.37 Observe on CRT

a. V 06	N 03	Flashing
b. R1		-00384
c. R2		+00384
d. R3		+00003

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6.2.21.3.29 Set the OPTICS MODE Switch on the Indicator Control panel to ZERO for 30 seconds, then return to MAN.

6.2.21.3.30 Insert in K148

a. VERB 33, ENTER

6.2.21.3.31 Observe on CRT

a. V 06	N 03	Flashing
b. R1		-00135
c. R2		+00135
d. R3		+00003

6.2.21.3.32 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-5.88 ±0.35 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	+5.88 ±0.35 degrees

6.2.21.3.33 Insert in K148

a. VERB 33, ENTER

6.2.21.3.34 Observe on CRT

a. V 06	N 03	Flashing
b. R1		-00160
c. R2		+00160
d. R3		+00003

6.2.21.3.35 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-6.95 ±0.41 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	+6.95 ±0.41 degrees

6.2.21.3.36 Insert in K148

a. VERB 33, ENTER

6.2.21.3.37 Observe on CRT

a. V 06	N 03	Flashing
b. R1		-00384
c. R2		+00384
d. R3		+00003

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6.2.21.3.38 Record CRT indications

- | | | | |
|----|---------|-------------------------|----------------------|
| a. | CG 3722 | TRUNNION CDU DAC OUTPUT | -16.88 ±1.00 degrees |
| b. | CG 3721 | SHAFT CDU DAC OUTPUT | +16.88 ±1.00 degrees |

6.2.21.3.39 Insert in K148

- a. VERB 33, ENTER

6.2.21.3.40 Observe on CRT

- | | | | |
|----|------|------|----------|
| a. | V 06 | N 03 | Flashing |
| b. | R1 | | -00385 |
| c. | R2 | | +00385 |
| d. | R3 | | +00003 |

6.2.21.3.41 Record CRT indications

- | | | | |
|----|---------|-------------------------|----------------------|
| a. | CG 3722 | TRUNNION CDU DAC OUTPUT | -16.88 ±1.00 degrees |
| b. | CG 3721 | SHAFT CDU DAC OUTPUT | +16.88 ±1.00 degrees |

6.2.21.3.42 Insert in K148

- | | | | |
|----|--------|------|-------|
| a. | V 34 | | ENTER |
| b. | V 40 | N 20 | ENTER |
| c. | V 41 | N 20 | ENTER |
| d. | +00000 | | ENTER |
| e. | +00000 | | ENTER |
| f. | +00000 | | ENTER |

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6.2.21.3.38 Record CRT indications

- | | | |
|------------|-------------------------|----------------------|
| a. CG 3722 | TRUNNION CDU DAC OUTPUT | -16.88 ±1.00 degrees |
| b. CG 3721 | SHAFT CDU DAC OUTPUT | +16.88 ±1.00 degrees |

6.2.21.3.39 Insert in K148

- a. VERB 33, ENTER

6.2.21.3.40 Observe on CRT

- | | | |
|---------|------|----------|
| a. V 06 | N 03 | Flashing |
| b. R1 | | -00385 |
| c. R2 | | +00385 |
| d. R3 | | +00003 |

6.2.21.3.41 Record CRT indications

- | | | |
|------------|-------------------------|----------------------|
| a. CG 3722 | TRUNNION CDU DAC OUTPUT | -16.88 ±1.00 degrees |
| b. CG 3721 | SHAFT CDU DAC OUTPUT | +16.88 ±1.00 degrees |

6.2.21.3.42 Insert in K148

- | | | |
|-----------|------|-------|
| a. V 34 | | ENTER |
| b. V 40 | N 20 | ENTER |
| c. V 41 | N 20 | ENTER |
| d. +00000 | | ENTER |
| e. +00000 | | ENTER |
| f. +00000 | | ENTER |

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APPENDIX I

<u>Signal</u>	<u>Nomenclature</u>	<u>G&N Test Requirement</u>	<u>PSAAM and/or SCA Uncertainty % of Full Scale</u>
CG 1020	+14 VDC CMC SUPPLY	+14.0 ± 0.4 VDC	0%
CG 1030	+4 VDC CMC SUPPLY	+4.00 ± 0.2 VDC	0%
CG 1040	+120 VDC PIPA SUPPLY	+120 ± 6.0 VDC	1%
CG 1051	+20 VDC PIPA SUPPLY	+20.0 ± 1.2 VDC	0%
CG 1052	-20 VDC PIPA SUPPLY	-20 ± 2 VDC	0%
CG 1070	+4 VDC CDU SUPPLY	+4.0 ± 0.2 VDC	0%
CG 1100	-28 VDC SUPPLY	-27.5 ± 6.0 VDC	0%
CG 1110	2.5 VDC TM BIAS	+2.50 ± 0.05 VDC	0%
CG 1201	IMU 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	1%
CG 1202	IMU 28V .8 KC 5% - 90° RMS	28.0 ± 1.4 VRMS	1.5%
CG 1203	IMU 28V .8KC 0° RMS	28.0 ± 2.1 VRMS	1.5%
CG 1207	PH DIFF IMU 5% 0°, -90°	90 ± 10°	3%
CG 1211	OPTX 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	1.5%
CG 1212	OPTX 28V .8KC 5% -90° RMS	28.00 ± 1.48 VRMS	1.5%
CG 1220	PH DIFF OPTX 1% IMU 1%	0° ± 10°	3%
CG 1331	3.2 KC 28V SUPPLY	28.6 ± 0.56 VRMS	1%
CG 1336	PH DIFF 3.2 KC 28V/CMC SYNC	0° ± 10°	3%
CG 1500	+28 VDC IMU OPERATE BUS	28.8 ± 3VDC	0%
CG 1510	+28 VDC IMU STANDBY BUS	28.8 ± 3 VDC	0%
CG 1520	+28 VDC CMC OPERATE BUS	28.8 ± 3 VDC	0%
CG 1530	+28 VDC OPTX OPERATE BUS	28.8 ± 3 VDC	0%
CG 2001	X PIPA SG O/P	5 VRMS max	3%
CG 2021	Y PIPA SG O/P	5 VRMS max	3%
CG 2041	Z PIPA SG O/P	5 VRMS max	3%
CG 2108	IG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2112	IG LX RESOLVER O/P SIN	(18.38 ± 1.84)	2.5%
CG 2113	IG LX RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2117	IG SERVO ERROR IN PHASE	0.0 ± 60mv RMS @ null	2%
CG 2120	IG TORQUE MOTOR CURRENT	0.125 amp max during Fine Alignment Torquing	2%
CG 2138	MG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2142	MG LX RESOLVER O/P SIN	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2143	MG LX RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2147	MG SERVO ERROR IN PHASE	0.0 ± 60 mv rms @ null	2%
CG 2150	MG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	2%
CG 2168	OG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2172	OG LX RESOLVER O/P SIN	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2173	OG LX RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2177	OG SERVO ERROR IN PHASE	0.0 ± 60mvRMS @ null	2%
CG 2180	OG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	2%

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APPENDIX I

Signal	Nomenclature	G&N Test Requirement	PSAAM and/or SCA Uncertainty % of Full Scale
CG 1020	+14 VDC CMC SUPPLY	+14.0 ± 0.4 VDC	0%
CG 1030	+4 VDC CMC SUPPLY	+4.00 ± 0.2 VDC	0%
CG 1040	+120 VDC PIPA SUPPLY	+120 ± 6.0 VDC	1%
CG 1051	+20 VDC PIPA SUPPLY	+20.0 ± 1.2 VDC	0%
CG 1052	-20 VDC PIPA SUPPLY	-20 ± 2 VDC	0%
CG 1070	+4 VDC CDU SUPPLY	+4.0 ± 0.2 VDC	0%
CG 1100	-28 VDC SUPPLY	-27.5 ± 6.0 VDC	0%
CG 1110	2.5 VDC TM BIAS	+2.50 ± 0.05 VDC	0%
CG 1201	IMU 28V .8KC 1/4 0° RMS	28.00 ± 0.56 VRMS	1%
CG 1202	IMU 28V .8 KC 5% - 90° RMS	28.0 ± 1.4 VRMS	1.5%
CG 1203	IMU 28V .8KC 0° RMS	28.0 ± 2.1 VRMS	1.5%
CG 1207	PH DIFF IMU 5% 0°, -90°	90 ± 10°	3%
CG 1211	OPTX 28V .8KC 1/4 0° RMS	28.00 ± 0.56 VRMS	1.5%
CG 1212	OPTX 28V .8KC 5% -90° RMS	28.00 ± 1.48 VRMS	1.5%
CG 1220	PH DIFF OPTX 1/4 IMU 1/4	0° ± 10°	3%
CG 1331	3.2 KC 28V SUPPLY	28.6 ± 0.56 VRMS	1%
CG 1336	PH DIFF 3.2 KC 28V/CMC SYNC	0° ± 10°	3%
CG 1500	+28 VDC IMU OPERATE BUS	28.8 ± 3VDC	0%
CG 1510	+28 VDC IMU STANDBY BUS	28.8 ± 3 VDC	0%
CG 1520	+28 VDC CMC OPERATE BUS	28.8 ± 3 VDC	0%
CG 1530	+28 VDC OPTX OPERATE BUS	28.8 ± 3 VDC	0%
CG 2001	X PIPA SG O/P	5 VRMS max	3%
CG 2021	Y PIPA SG O/P	5 VRMS max	3%
CG 2041	Z PIPA SG O/P	5 VRMS max	3%
CG 2108	IG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2112	IG 1X RESOLVER O/P SIN	(18.38 ± 1.84) 19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2113	IG 1X RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2117	IG SERVO ERROR IN PHASE	0.0 ± 60mv RMS @ null	2%
CG 2120	IG TORQUE MOTOR CURRENT	0.125 amp max during Fine Alignment Torquing	2%
CG 2138	MG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2142	MG 1X RESOLVER O/P SIN	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2143	MG 1X RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2147	MG SERVO ERROR IN PHASE	0.0 ± 60 mv rms @ null	2%
CG 2150	MG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	2%
CG 2168	OG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2172	OG 1X RESOLVER O/P SIN	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2173	OG 1X RESOLVER C/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2177	OG SERVO ERROR IN PHASE	0.0 ± 60mvRMS @ null	2%
CG 2180	OG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	2%

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<u>Signal</u>	<u>Nomenclature</u>	<u>G&N Test Requirement</u>	<u>PSAAM and/or SCA Uncertainty % of Full Scale</u>
CG 2219	PITCH ATT ERROR - CDU DAC O/P	5.06 ± 0.5 VRMS @ 17°	2%
CG 2220	IG CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 2221	IG CDU COARSE ERROR	0.0 ± 0.68 VRMS @null	1%
CG 2249	YAW ATT ERROR-CDU DAC O/P	5.06 ± 0.5VRMS @ 17°	2%
CG 2250	MG CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 2251	MG CDU COARSE ERROR	0.0 ± 0.68VRMS @ null	1%
CG 2279	ROLL ATT ERROR-CDU DAC O/P	5.06 ± 0.5VRMS @17°	2%
CG 2280	OG CDU FINE ERROR	0.0 ± 0.07 VRMS 2 null	1%
CG 2281	OG CDU COARSE ERROR	0.0 ± 0.68 VRMS	1%
CG 2300	PIPA TEMPERATURE	130 ± 1.5°F Operate Mode	0%
CG 3011	TRUNNION CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 3021	SHAFT CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 3117	SXT SHAFT SERVO ERROR IN PH	2 VRMS max	2%
CG 3118	SXT TRUNNION SERVO ERROR IN PHASE	2 VRMS max	2%
CG 3140	SXT SHAFT TACH O/P	3.1 ± 1.1VRMS @ Hi Rate	2%
CG 3145	SXT SHAFT MIR CONTROL WINDING	3.3 ± 1.3VRMS @ Hi Rate	2%
CG 3150	SXT TRUNNION TACH O/P	3.3 ± 1.3VRMS @ Hi Rate	2%
CG 3155	SXT TRUNNION MIR CONTROL WINDING	0.85 ± 0.35VRMS at Hi Rate	2%
CG 3160	SCT SHAFT TACH O/P	3.3 ± 1.3 VRMS @ Hi Rate	2%
CG 3170	SCT TRUNNION TACH O/P	0.85 ± 0.35VRMS @Hi Rate	2%
CG 3721	SHAFT CDU DAC O/P	5.06 ± 0.50VRMS @17°	1%
CG 3722	TRUNNION CDU DAC O/P	5.06 ± 0.50VRMS @ 17°	1%
CG 4300	CMC TEMP	87.5±42.5°F	0%
CG 6020	PIPA CAL MODULE TEMP	72.5±27.5°F	0%
CG 6021	IMU 800 cps 5% TEMP (PSA)	90±30°F	0%
CG 2301	IRIG TEMPERATURE	135 ± 2.5°F in Operate	0%

All uncertainties specified above and those due to instrumentation in the ACE equipment shall be root sum squared with the basic system tolerances to yield an acceptable tolerance for use when testing the G&N System in the spacecraft.

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NUMBER	REVISION LETTER						PAGE

<u>Signal</u>	<u>Nomenclature</u>	<u>G&N Test Requirement</u>	<u>PSAAM and/or SCA Uncertainty % of Full Scale</u>
CG 2219	PITCH ATT ERROR - CDU DAC O/P	5.06 ± 0.5 VRMS @ 17°	2%
CG 2220	IG CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 2221	IG CDU COARSE ERROR	0.0 ± 0.68 VRMS @null	1%
CG 2249	YAW ATT ERROR-CDU DAC O/P	5.06 ± 0.5VRMS @ 17°	2%
CG 2250	MG CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 2251	MG CDU COARSE ERROR	0.0 ± 0.68VRMS @ null	1%
CG 2279	ROLL ATT ERROR-CDU DAC O/P	5.06 ± 0.5VRMS @17°	2%
CG 2280	OG CDU FINE ERROR	0.0 ± 0.07 VRMS 2 null	1%
CG 2281	OG CDU COARSE ERROR	0.0 ± 0.68 VRMS	1%
CG 2300	PIPA TEMPERATURE	130 ± 1.5°F Operate Mode	0%
CG 3011	TRUNNION CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 3021	SHAFT CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 3117	SXT SHAFT SERVO ERROR IN PH	2 VRMS max	2%
CG 3118	SXT TRUNNION SERVO ERROR IN PHASE	2 VRMS max	2%
CG 3140	SXT SHAFT TACH O/P	3.1 ± 1.1VRMS @ Hi Rate	2%
CG 3145	SXT SHAFT MTR CONTROL WINDING	3.3 ± 1.3VRMS @ Hi Rate	2%
CG 3150	SXT TRUNNION TACH O/P	3.3 ± 1.3VRMS @ Hi Rate	2%
CG 3155	SXT TRUNNION MTR CONTROL WINDING	0.85 ± 0.35VRMS at Hi Rate	2%
CG 3160	SCT SHAFT TACH O/P	3.3 ± 1.3 VRMS @ Hi Rate	2%
CG 3170	SCT TRUNNION TACH O/P	0.85 ± 0.35VRMS @Hi Rate	2%
CG 3721	SHAFT CDU DAC O/P	5.06 ± 0.50VRMS @17°	1%
CG 3722	TRUNNION CDU DAC O/P	5.06 ± 0.50VRMS @ 17°	1%
CG 4300	CMC TEMP	87.5±42.5°F	0%
CG 6020	PIPA CAL MODULE TEMP	72.5±27.5°F	0%
CG 6021	IMU 800 cps 5% TEMP (PSA)	90±30°F	0%
CG 2301	IRIG TEMPERATURE	135 ± 2.5°F in Operate	0%

All uncertainties specified above and those due to instrumentation in the ACE equipment shall be root sum squared with the basic system tolerances to yield an acceptable tolerance for use when testing the G&N System in the spacecraft.

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ADDENDUM I

Scope: The following changes are required to make ND1002325 applicable as G&N System technical support documentation for CSM 101.

- Addition 1: Page 50 paragraph 6.2.7.2.6. Add the following:
During this 12 minute period monitor IG TORQUE MOTOR CURRENT (CG 2120) on the CRT. This measurement shall not exceed 0.125 amp.
- Addition 2: Page 51 paragraph 6.2.7.3.5. Add the following:
During this 12 minute period monitor OG TORQUE MOTOR CURRENT (CG 2180) on the CRT. This measurement shall not exceed 0.125 amp.
- Addition 3: Page 53, paragraph 6.2.7.4.5. Add the following:
During this 5 minute period monitor MG TORQUE MOTOR CURRENT (CG 2150) on the CRT. This measurement shall not exceed 0.125 amp.
- Addition 4: Page 41. Add 6.2.4.14 On the Event Recorder verify that the IMU HTR CURRENT (CG 2302) discrete and IMU BLOWER CURRENT (CG 2303) discrete are cycling on and off.
- Addition 5: Page 71 paragraph 6.2.13.6 Add the following step prior to 6.2.13.6:
During the Trunnion Slew Rate Test HI Speed (6.2.13.6) monitor and verify the following signals on the CRT.

Signal	Requirement
a. TRUNNION CDU FINE ERROR (CG 3011)	$\pm .07$ VRMS Max.
b. SXT TRUNNION TACH O/P (CG 3150)	3.3 ± 1.3 VRMS
c. SCT TRUNNION TACH O/P (CG 3170)	0.85 ± 0.35 VRMS

- Addition 6: Page 72 paragraph 6.2.13.9. Add the following step prior to 6.2.13.9:
During the Shaft Slew Rate Test - HI speed (6.2.13.9) monitor and verify the following signals on the CRT.

Signal	Requirement
a. SHAFT CDU FINE ERROR (CG 3021)	$\pm .07$ VRMS Max.
b. SXT SHAFT TACH O/P (CG 3140)	3.3 ± 1.3 VRMS
c. SCT SHAFT TACH O/P (CG 3160)	3.3 ± 1.3 VRMS

- Addition 7: Page 16 paragraph 6.1.2.1 Add new paragraph 6.1.2.1.5 as follows:
Data from the on board tape recorder shall be made available and the following signals verified.

- a. VIB NG ROLL (CG 6001)
- b. VIB NB PITCH (CG 6002)
- c. VIB NB YAW (CG 6003)

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ADDENDUM I

Scope: The following changes are required to make ND1002325 applicable as G&N System technical support documentation for CSM 101.

Addition 1: Page 50 paragraph 6.2.7.2.6. Add the following:
During this 12 minute period monitor IG TORQUE MOTOR CURRENT (CG 2120) on the CRT. This measurement shall not exceed 0.125 amp.

Addition 2: Page 51 paragraph 6.2.7.3.5. Add the following:
During this 12 minute period monitor OG TORQUE MOTOR CURRENT (CG 2180) on the CRT. This measurement shall not exceed 0.125 amp.

Addition 3: Page 53, paragraph 6.2.7.4.5. Add the following:
During this 5 minute period monitor MG TORQUE MOTOR CURRENT (CG 2150) on the CRT. This measurement shall not exceed 0.125 amp.

Addition 4: Page 41. Add 6.2.4.14 On the Event Recorder verify that the IMU HTR CURRENT (CG 2302) discrete and IMU BLOWER CURRENT (CG 2303) discrete are cycling on and off.

Addition 5: Page 71 paragraph 6.2.13.6 Add the following step prior to 6.2.13.6:
During the Trunnion Slew Rate Test HI Speed (6.2.13.6) monitor and verify the following signals on the CRT.

Signal	Requirement
a. TRUNNION CDU FINE ERROR (CG 3011)	$\pm .07$ VRMS Max.
b. SXT TRUNNION TACH O/P (CG 3150)	3.3 ± 1.3 VRMS
c. SCT TRUNNION TACH O/P (CG 3170)	0.85 ± 0.35 VRMS

Addition 6: Page 72 paragraph 6.2.13.9. Add the following step prior to 6.2.13.9:
During the Shaft Slew Rate Test - HI speed (6.2.13.9) monitor and verify the following signals on the CRT.

Signal	Requirement
a. SHAFT CDU FINE ERROR (CG 3021)	$\pm .07$ VRMS Max.
b. SXT SHAFT TACH O/P (CG 3140)	3.3 ± 1.3 VRMS
c. SCT SHAFT TACH O/P (CG 3160)	3.3 ± 1.3 VRMS

Addition 7: Page 16 paragraph 6.1.2.1 Add new paragraph 6.1.2.1.5 as follows:
Data from the on board tape recorder shall be made available and the following signals verified.

- VIB NG ROLL (CG 6001)
- VIB NB PITCH (CG 6002)
- VIB NB YAW (CG 6003)

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ADDENDUM II

Scope: The following changes are required to make ND1002325 applicable as G&N System technical support documentation for systems containing SUNDIAL C test ropes.

- Change 1: Pages 56 through 61, paragraphs 6.2.9.1.4, 6.2.9.2a, 6.2.9.3a, 6.2.9.5a, 6.2.9.6a, 6.2.9.7a, 6.2.9.8, 6.2.9.10a, 6.2.9.11a, 6.2.9.13a, 6.2.9.15a, 6.2.9.16a, 6.2.9.22. In each of these paragraphs change "VERB 06 NOUN XX flashing" to "VERB 33 NOUN XX flashing."
- Change 2: Pages 106 through 115, paragraphs 6.2.21.2.2a, 6.2.21.2.4a, 6.2.21.2.7a, 6.2.21.2.10a, 6.2.21.2.13a, 6.2.21.2.16a, 6.2.21.2.19a, 6.2.21.2.22a, 6.2.21.2.25a, 6.2.21.2.28a, 6.2.21.2.31a, 6.2.21.2.34a, 6.2.21.2.37a, 6.2.21.3.8a, 6.2.21.3.11a, 6.2.21.3.14a, 6.2.21.3.17a, 6.2.21.3.20a, 6.2.21.3.24a, 6.2.21.3.27a, 6.2.21.3.31a, 6.2.21.3.34a, 6.2.21.3.37a, 6.2.21.3.40a, In each of these steps change "V06" to "V33".

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ADDENDUM II

Scope: The following changes are required to make ND1002325 applicable as G&N System technical support documentation for systems containing SUNDIAL C test ropes.

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- Change 2: Pages 106 through 115, paragraphs 6.2.21.2.2a, 6.2.21.2.4a, 6.2.21.2.7a, 6.2.21.2.10a, 6.2.21.2.13a, 6.2.21.2.16a, 6.2.21.2.19a, 6.2.21.2.22a, 6.2.21.2.25a, 6.2.21.2.28a, 6.2.21.2.31a, 6.2.21.2.34a, 6.2.21.2.37a, 6.2.21.3.8a, 6.2.21.3.11a, 6.2.21.3.14a, 6.2.21.3.17a, 6.2.21.3.20a, 6.2.21.3.24a, 6.2.21.3.27a, 6.2.21.3.31a, 6.2.21.3.34a, 6.2.21.3.37a, 6.2.21.3.40a, In each of these steps change "V06" to "V33".

APOLLO G&N Specification
ND 1002325 REV D

Original Issue Date:
Release Authority: TIRR 3/4/4
Class A Release

POST INSTALLATION CHECKOUT PROCESS
SPECIFICATION FOR THE APOLLO GUIDANCE
AND NAVIGATION SYSTEM -- BLOCK II

Record of Revisions

Date	Revision Letter	TIRR No.	Pages Revised	Approvals	
				AC	NASA
11/1/66	A	31765	1-116 was 116 pages, now 118 pages. ²⁰⁰	EA	WLS
1/26/67	B	32784	2, 3, 6, 9, 11, 15, 16, 24, 27, 29, 34, 39	EA	--
			44-50, 54, 56-59, 61-65, 67, 68, 72-74, 76-79, 81-103, 106-117;		
			was 118 pages, now 119 pages. ²⁰⁰		
2/7/67	C	32919	10-119, Was 119 pages now 124		
4/6/67	D	33539	8, 9, 10, 12, 15, 24, 35, 38, 40, 41,	EA	-
			43-46, 50-56, 58-78, 81, 83-87, 89,		
			95-124.		

This specification consists of page 1 to 124 including Appendix I pages 120, 121 and Addendum I, pages 122 and 123 and Addendum II, page 124.

APPROVALS	NOT REQUIRED PER CCA497-0274 NASA/MSC				<i>Robert A. Z...</i> ACED
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5.4 Test Sequence

- 5.4.1 The test sequence normally should follow the flow outlined by Figure 1 in the order specified except 6.2.5. Turn On and Turn Off procedure, which may be performed as the requirement arises.

TABLE I G&N TESTS

Paragraph No.

6.1.3	Prepower Application Tests (Part of G&N Installation OCP)
6.2.1	Application of Standby Power to G&N System
6.2.2	CMC Operational Test
6.2.3	Operate Power On Test
6.2.4	G&N Power Supplies Test
6.2.5	General Turn Off and Turn On Procedure
6.2.6	G&N Operational Test
6.2.7	Gimbal Friction Test
6.2.8	G&N Panel Brightness & Lamp Test
6.2.9	Semi-Automatic Mode Control Test
6.2.10	Zero Optics Test
6.2.11	Optics Coordinate Transformation Control Test
6.2.12	Optics Positional Accuracy Test
6.2.13	Optics Slew Rate Test
6.2.14	Stabilization Loop Step Response Test
6.2.15	IRIG Scale Factor Test
6.2.16	IMU Performance Test
6.2.17	Fine Alignment Test SXT-NB-IMU
6.2.18	Gyrocompassing Test
6.2.19	Voltage Margin Test
6.2.21	S/C Control & Display Test

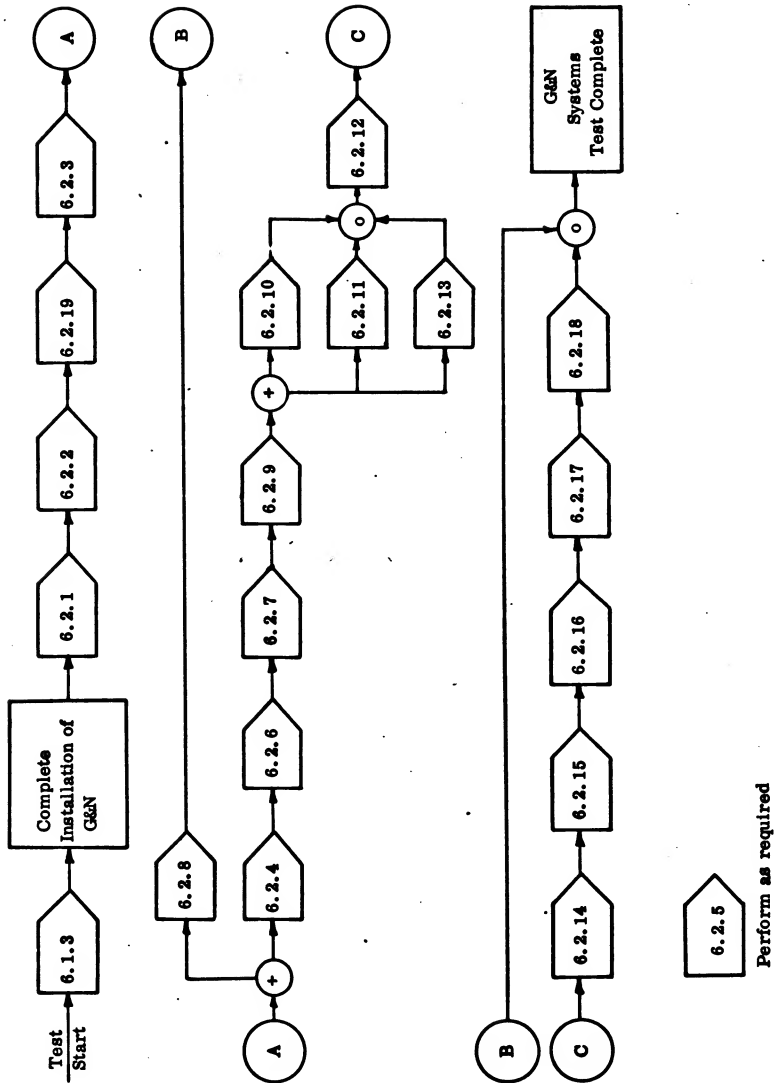


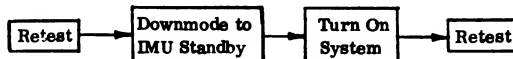
FIGURE 1 - G&N INDIVIDUAL SYSTEMS TEST SEQUENCE

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5.4.2 Failure of the D criteria for IRIG and PIPA parameters.

- 5.4.2.1 If D_1 , D_2 , or D_3 exceeds its maximum value as specified in Table D paragraph 6.2.16.10.8 for any IRIG or PIPA, that IRIG or PIPA shall be retested in the sequence indicated below. The coefficient stability terms shall then be recalculated.



RETEST SEQUENCE

If D_1 , D_2 , or D_3 exceeds its maximum value after the retest sequence is completed, the requirements of 5.4.2.2.(IRIG) or 5.4.2.3 (PIPA) shall apply. If D_1 , D_2 , and D_3 are within tolerances specified in Table D after the retest sequence is completed, the original out-of-tolerance D terms calculated in para 6.2.16.10.8 shall be exonerated.

5.4.2.2 IRIG stability requirements.

- 5.4.2.2.1 Failure to be within the maximum values for D_1 or D_2 or D_3 after the retest sequence shall constitute failure of the unit.

5.4.2.3 PIPA stability requirements.

- 5.4.2.3.1 Failure to be within the maximum limits of D_1 or D_2 or D_3 after the retest sequence constitute failure of the unit.

- 5.5 Retest subsequent to replacement of a malfunctioned assembly with that of a flight certified assembly shall be at the discretion of NASA Engineering. Table II can be used as a guide to determine general retest requirements. In all retest procedures, the test sequence of Figure 1 shall be adhered to.

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TABLE II														
RETEST MATRIX														
Paragraph Number	Test Title	IMU	NAV BASE	OPTICS	CMC	PSA	LEB DSKY	MDC DSKY	SIGN COND	CDU	G&N HARNESS	PIPA ELECT.	INDICATOR CONTROL PANEL	
6.1.3	Pre-Power Application Tests	X	X	X	X	X	X	X	X	X	X	X	X	
6.2.1	Application of Standby Power to G&N System	X	X		X	X	X	X	X	X	X	X		
6.2.5	General Turn OFF and Turn ON Procedure	*	*	*	*	*	*	*	*	*	*	*	*	
6.2.3	Operate Power On Test	X	X		X	X	X	X	X	X	X	X	X	
6.2.2	CMC Operational Test	X	X		X	X	X	X	X	X	X	X	X	
6.2.8	G&N Panel Brightness and Lamp Test	X	X	X	X	X	X	X	X	X	X	X	X	
6.2.6	G&N Operational Test	X	X	X	X	X	X	X	X	X	X	X	X	
6.2.10	Zero Optics Test	X	X	X	X	X	X	X	X	X	X	X	X	
6.2.13	Optics Slew Rate Test	X	X	X	X	X	X	X	X	X	X	X	X	
6.2.11	Optics Coordinate Transformation Control	X	X	X	X	X	X	X	X	X	X	X	X	
6.2.12	Optics Positional Accuracy Test		X	X	X	X	X	X	X	X	X	X	X	
6.2.9	Semi-Automatic Mode Control Test	X	X	X	X	X	X	X	X	X	X	X	X	
6.2.14	Stab Loop Step Response Test	X	X											
6.2.15	IRIG Scale Factor Test	X	X	X	X	X	X	X	X	X	X	X	X	
6.2.16	IMU Performance Test	X	X	X	X	X	X	X	X	X	X	X	X	
6.2.17	Fine Alignment Test	X	X	X	X	X	X	X	X	X	X	X	X	
6.2.19	Voltage Margin Test	X	X											
6.2.7	Gimbal Friction Test	X	X											
6.2.18	Gyrocompassing Test	X	X											
6.2.4	G&N Power Supplies Test	X	X											
6.2.21	Spacecraft Control and Displays Test	X	X											

* To be used as necessary to turn system on and off.

* To be used as necessary to turn system on and off.

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6.0 DETAIL REQUIREMENTS

6.1 Initial Test Conditions

6.1.1 The following precautions shall be observed to preclude loss of continuity in inertial component performance history of the IMU. Deviation may necessitate recalibration of the inertial components.

6.1.1.1 The IMU shall be supplied with heater power on a continuous basis. When S/C Ground Power Supply, Model No. C14-418 is not providing heater power, then heater power shall be supplied through the Inertial Components Temperature Controller (ICTC) Model No. 513-100. The temperature of the IRIG's shall be maintained between 120° and 150°F. The temperature of the PIPA's shall be maintained between 115° and 145°F.

6.1.1.2 The Standby Mode is identified by the circuit breakers IMU HTR MN A, IMU HTR MN B, COMPUTER MN A and MN B in the ON position and IMU MN A and MN B and the G&N Power-IMU switch on LEB Lighting Control Panel in the OFF position. The Operate Mode is identified by the circuit breaker IMU HTR MN A, MN B, COMPUTER MN A and MN B in the ON position and IMU MN A and MN B and the G&N Power-IMU switch on the LEB Lighting Control Panel in the ON position. The G&N System shall be operating in the Standby Mode with CMC power ON for a minimum of two hours prior to advancing to the IMU Operate Mode. In the event Standby or CMC power is interrupted, an equivalent time period, but not less than 15 minutes, shall be allowed when power is restored before advancing to the Operate Mode, except that when the interval of interruption exceeds two hours, a two-hour warmup period shall be mandatory (exceptions to the 2-hour warmup are noted in 6.2.5.2.).

6.1.1.3 The Inertial Measurement Unit shall not be without heater power for more than 15 minutes.

6.1.1.4 During the turn on of the G&N power, COMPUTER MN A and MN B and IMU HTR MN A and IMU HTR MN B circuit breakers must be turned on before the IMU MN A and IMU MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. During the turn off of the G&N power the IMU MN A and IMU MN B circuit breakers must be turned off before the IMU HTR MN A and IMU HTR MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. In no case shall COMPUTER MN A and MN B circuit breaker be turned off before IMU MN A and MN B circuit breakers.

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6.2 Test Procedures

6.2.1 Application of Standby Power to G&N System

- 6.2.1.1 Verify that spacecraft power checks, to include polarity and magnitude on Spacecraft Power Connector, have been made as specified in 6.1.3.
- 6.2.1.2 All power and control switches on the G&N Indicator Control Panel shall be placed in the OFF or neutral position.
- 6.2.1.3 The Inertial Component Temperature Controller (ICTC) shall be supplying inertial component heater power to the G&N System through the PSA, Connector No. 45J2.
- 6.2.1.4 Computer Power On
- 6.2.1.4.1 Set G&N COMPUTER MN A and MN B Breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in).
- 6.2.1.4.2 Set the POWER-AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in), and position G/N POWER switch to AC1.
- 6.2.1.4.3 Set the computer numerical display lights to the minimum acceptable brightness by rotating the BRIGHTNESS Controls on the MDC and LEB Lighting Control Panels.
- 6.2.1.4.4 The +28 VDC CMC OPERATE voltage (CG 1520) shall be $+28.8 \pm 3$ VDC. Verify CRT indication.
- 6.2.1.4.5 Using DSKY, enter VERB 36, ENTR, then press RESET. All computer alarms on the Main Display Console (MDC), LEB CMC DSKY and CRT shall clear.
- 6.2.1.4.6 The voltage output of the +4 VDC CMC supply shall be $+4.00 \pm 0.20$ VDC, (CG 1030). The value on the CRT shall be recorded.
- 6.2.1.4.7 The voltage output of the +14 VDC CMC supply shall be $+14.0 \pm 0.4$ VDC, (CG 1020). The value on the CRT shall be recorded.
- 6.2.1.4.8 Verify that the CMC is in the Backup Mode by monitoring on the CRT that the Program indicates 00, and the Program readouts on the MDC and LEB AGC DSKY indicate 00.

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- 6.2.2.11 CMC Clock Frequency Test
- 6.2.2.11.1 Insure that the CMC is in the Standby Mode by verifying that the STBY pushbutton on the DSKY's is lit. If it is not lit enter VERB 60, ENTER into the DSKY. Push and hold the STBY pushbutton until it lights. Verify that the NO ATT and TEMP lamps on the DSKY's light.
- 6.2.2.11.2 Insure that the IMU 3.2 kc 28V Supply is available on the vertical input to PIPA Scope.
- 6.2.2.11.3 Insure that the EPUT Meter and preset counter plug-in unit are connected to 115V, 60 cps power.
- 6.2.2.11.3.1 Permit the EPUT to warm up for the length of time required by the manufacturer's specification.
- 6.2.2.11.4 Connect the signal output from Oscilloscope 4A4-A1 to the input channel on the EPUT Meter.
- 6.2.2.11.5 Set the preset counter to indicate 96000.
- 6.2.2.11.6 Set the EPUT meter to count at the maximum count rate (1 megacycle or greater).
- 6.2.2.11.7 Adjust the Trigger Level to the point midway between the range over which the counter will normally count.
- 6.2.2.11.8 Each count cycle shall last approximately 30 seconds. Adjust the display time to permit recording the display on the EPUT.
- 6.2.2.11.9 Record the results of 10 count-cycles. Calculate the average time per cycle over the 10 cycles. Record the result.
- 6.2.2.11.10 Divide 96000 by the average time from 6.2.2.11.9. Record the result as 3200 cps frequency.
- 6.2.2.11.11 Multiply the 3200 cps frequency by 320. Record the result as the CMC clock frequency.
- 6.2.2.11.11.1 The CMC Clock Frequency shall be 1024KC ± 2 parts per million.
- 6.2.2.11.12 Remove the CMC from Standby Mode by performing the following DSKY operations.
- Press and hold the STBY pushbutton until it extinguishes.
 - Press the RESET pushbutton.
 - VERB 61, ENTER
 - VERB 36, ENTER.

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6.2.3.1.7 Insure that the following alarm lamps are not lighted on G&N LEB Display Panel.

- a. CMC Warning
- b. ISS Warning
- c. PGNS Caution

6.2.3.1.8 Verify that the PROGRAM ALARM lamp on the DSKY's does not light with VERB 05 NOUN 31 and R1 = 00213 displayed.

6.2.3.1.9 The OG, IG, and MG CDU angles shall be 00000±00150. Verify on CRT.

6.2.3.1.10 Enter the following into K-148:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.3.1.11 Verify that the following secondary power supply voltages are not flashing on the CRT display.

Table VI. Secondary Power Supply Voltages

Meas. No.	Signal
1 CG 1040	+120 VDC PIPA SUPPLY
2 CG 1051	+20 VDC PIPA SUPPLY
3 CG 1052	-20 VDC PIPA SUPPLY
4 CG 1070	+4 VDC CDU SUPPLY
5 CG 1100	-28 VDC ELECTRONICS
6 CG 1020	+14 VDC CMC SUPPLY
7 CG 1030	+4 VDC CMC SUPPLY
8 CG 1201	IMU 28V 800 CPS 1 pct 0 ph
9 CG 1202	IMU 28V 800 CPS 5 pct ph A
10 CG 1203	IMU 28V 800 CPS 5 pct ph B
11 CG 1331	3.2KC 28V SUPPLY
12 CG 1110	2.5 VDC TM BIAS

6.2.3.1.12 15 minutes after the application of IMU OPERATE power record PIPA TEMP (CG 200) displayed on the CRT.

6.2.3.1.13 30 minutes after the application of IMU OPERATE power record IRIG TEMP (CG 2301) displayed on the CRT.

6.2.3.1.14 1 hour after the application of IMU OPERATE power monitor and record PIPA TEMP (CG 2300) and IRIG TEMP (CG 2301) every 5 minutes for 1 hour. Verify that each reading does not deviate from the average of each signal by more than 0.1°F.

6.2.3.1.15 When 2 hours have elapsed since the application of IMU OPERATE power record PIPA TEMP and IRIG TEMP. PIPA TEMP shall be 130.5° ±1.5°F. IRIG TEMP shall be 135° ±2.5°F. PIPA TEMP shall be within 0.5°F of that recorded in 6.2.3.1.12 and 6.2.1.5.4. IRIG TEMP shall be within 0.5°F of that recorded in 6.2.3.1.13.

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6.2.4 G & N System Power Supplies Test

6.2.4.1 Proceed with this test if 6.2.3, Operate Power On Test, has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding with this test. Insure that the IMU Operate Power has been on for at least 15 minutes before proceeding with this test.

6.2.4.2 Enter the following sequence into the K-Start. Verb 41 NOUN 20, ENTER; +00000 ENTER; +00000 ENTER, +00000 ENTER.

6.2.4.3 Insure that OPERATE power has been applied for at least 15 minutes. Verify that the discretes listed below have been issued by noting that the event lamps on the specified Event Module are illuminated.

- a. IMU STANDBY POWER (CG 1513)
- b. CMC OPERATE POWER (CG 1523)
- c. OPTX OPERATE POWER (CG 1533)

6.2.4.4 The IRIG and PIPA Pulse Torque DC supply shall demonstrate the following requirements. The DC output voltages shall be as follows: Record the indicated voltage displayed on the CRT.

- a. The 120 volt PIPA Power Supply output voltage shall be 120 ± 6 VDC (CG 1040).
- b. The PIPA +20 VDC Supply output voltage shall be $+20 \pm 1.2$ VDC (CG 1051).
- c. The PIPA -20 VDC output voltage shall be -20 ± 2 VDC (CG 1052). Record the voltages indicated on the CRT.

6.2.4.5 The minus 28 VDC Electronics Power Supply output voltage shall be -27.5 ± 6.0 VDC (CG 1100). Record the indicated voltage displayed on the CRT.

6.2.4.6 Power Supplies

Record the voltage indicated on the CRT, the CRT.

- a. The +14 VDC CMC Power output voltage shall be $+14.0 \pm 0.4$ VDC (CG 1020).
- b. The +4 VDC CMC Power Supply output voltage shall be $+4.00 \pm 0.20$ VDC (CG 1030).
- c. The +4 VDC CDU Power Supply output voltage shall be $+4.0 \pm 0.2$ VDC.
- d. The +2.50 TM BIAS Supply output voltage shall be 2.50 ± 0.05 vdc (CG 1110).

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6.2.4.7 Twenty-eight volt, 800 CPS Power Supplies - the following values shall be measured with the guidance reference clock synchronizing input pulses. Record the indicated voltage displayed on the CRT.

- a. IMU +28 V, 800 CPS 1 per cent 0 degree voltage shall be 28.0 ± 0.6 VAC (CG 1201).
- b. IMU 28 V, 800 CPS, 5 per cent Ph A -90 degree voltage shall be 28.0 ± 1.4 VAC (CG 1202).
- c. IMU +28 V, 800 CPS 5 per cent Ph B 0 degree voltage shall be 28.0 ± 2.1 VAC (CG 1203).
- d. Optics +28 V, 800 CPS 1 per cent 0 degree voltage shall be 28.0 ± 0.6 VAC (CG 1211).
- e. Optics +28 V, 800 CPS 5 per cent -90 degree voltage shall be 28.0 ± 1.5 VAC (CG 1212).

6.2.4.8 IMU 3200 CPS Supply

The 28 V 3200 CPS Supply feedback output voltage shall be 28.6 ± 0.6 volts RMS (CG 1331). Record the indicated voltage displayed on the CRT.

6.2.4.9 Plus 28 VDC Busses

Record the indicated voltage displayed on the CRT.

- a. The +28 VDC IMU OPERATE (Buss No. 1) output voltage shall be 28.8 (+3, -3) VDC under normal system load (CG 1500).
- b. The +28 VDC IMU STANDBY (Buss No. 2) output voltage shall be 28.8 (+3, -3) VDC under normal system load (CG 1510).
- c. The +28 VDC CMC OPERATE (Buss No. 3) output voltage shall be 28.8 (+3, -3) VDC under normal system load (CG 1520).
- d. The +28 VDC OPTX OPERATE (Buss No. 4) output voltage shall be 28.8 (+3, -3) VDC under normal system load (CG 1530).

6.2.4.10 Noise

- a. The +14 VDC CMC Power Supply RMS noise shall be less than 0.4 volt (CG 1021).
- b. The +4 VDC CMC Power Supply noise peak shall be less than 0.4 volt pp (CG 1031).

6.2.4.11 IMU 14/CMC Sync Phase Difference

The Phase difference between the 3.2 kc supply and CMC sync shall be $0^\circ \pm 10^\circ$ (NG 1336). Record the phase difference as indicated on the CRT.

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6.2.5 General Turn Off and Turn On Procedure

NOTE: This procedure shall be utilized any time after performing 6.1.3 Prepower Application Requirements, 6.2.1, Standby Power On Test, and 6.2.3. Operate Power on Test, to turn on or turn off the G&N System. Appropriate portions of this procedure will be referenced in other tests.

6.2.5.1 Turn Off Procedure

CAUTION: This procedure must be performed in the sequence specified. Failure to adhere to this sequence may require calibration of the inertial components.

6.2.5.1.1 Enter the following sequence into the K-148.

- a. VERB 41 NOUN 20, ENTER
- b. +00000 ENTER
- c. +00000 ENTER
- d. +09000 ENTER

Verify that the GIMBAL LOCK indicator on the DSKY's is illuminated.

6.2.5.1.2 Set the following switches on the G&N Indicator Control Panel to the positions designated.

- a. OPTICS MODE to MANUAL
- b. CONTROLLER MODE to DIRECT
- c. CONTROLLER SPEED to MED
- d. TELESCOPE TRUNNION to SLAVE TO SXT
- e. RETICLE BRIGHTNESS to minimum brightness position

6.2.5.1.3 Set the G/N Power - IMU switch on the LEB Lighting Control Panel to OFF and G&N IMU MN A and MN B circuit breakers on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).

6.2.5.1.4 Decrease the LIGHTS - NUMERICS controls on both the Left Hand Circuit Breaker panel and the LEB Lighting Control Panel to the minimum brightness - OFF position.

6.2.5.1.5 Set the PSAAM power switch on the PSAAM of OFF, and the Right Hand Circuit Breaker panel to OFF (breakers pulled out).

6.2.3.1.6 Set the IMU HTR MN A and MN B circuit breaker on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).

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- 6.2.5.1.7 Set the G&N Power AC1-OFF-AC2 Switch on the Right Hand Circuit breaker panel to OFF and the G&N POWER AC1 and AC2 circuit breakers to OFF (breakers pulled out).
- 6.2.5.1.8 Set the G/N POWER - OPTICS switch on the LEB Lighting Control Panel to OFF and G&N OPTICS MN A and MN B breakers on the Right Hand circuit breaker panel to OFF.
- 6.2.5.1.9 Set the COMPUTER MN A and MN B Circuit breakers on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).
- 6.2.5.1.10 Verify that the ICTC is supplying inertial components heater power to the G&N System. This will be indicated by the following on the PTC.
- a. G&N ON (PTC inhibit) light not illuminated.
 - b. IMU Temp/heater current meter indicates IMU temperature of $130^{\circ} \pm 5^{\circ}\text{F}$.
- 6.2.5.2 Turn ON Procedure
- 6.2.5.2.1 Set or verify the following G&N Indicator Control Panel switches to the position indicated.
- a. CONDITION LAMPS to ON
 - b. OPTICS MODE to MANUAL
 - c. CONTROLLER COUPLING to DIRECT
 - d. CONTROLLER SPEED to DIRECT
 - e. TELESCOPE TRUNNION to SLAVE to SXT
 - f. RETICLE BRIGHTNESS to minimum brightness position.
- 6.2.5.2.2 Insure that interfacing system EPS and ECS are turned on and operating properly.

CAUTION: The remaining procedure must be followed in sequence specified. Failure to adhere to this sequence may require recalibration of the inertial components.

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- 6.2.5.2.3 Energize the G&N COMPUTER MNA and MNB breakers on the Right Hand Circuit Breaker panel (Breakers pushed in). If the STBY indicator on the DSKY is illuminated, press the STBY pushbutton for approximately 3 seconds until the STBY indicator extinguishes. Enter VERB 61 into K148 and press the ENTER pushbutton. Verify +14 and +4 VDC CMC power supply outputs on CRT display. Voltages shall be +14.0±0.4 VDC (CG 1020) and +4.0±0.2 VDC (CG 1030).
- 6.2.5.2.4 Energize the G&N IMU HTR MNA and MNB breakers on the Right Hand Circuit Breaker panel (breakers pushed in). Insure that the CMC +28 VDC discrete lamp on the Event Module is illuminated (CG 1523).
- 6.2.5.2.5 Set the G&N POWER AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in). Set the G&N POWER AC1-OFF-AC2 switch to AC1.
- 6.2.5.2.5.1 Set the G&N DSKY and Display Panel brightness to the minimum acceptable level by manipulation of LIGHTS - NUMERICS control on both Left Hand circuit breaker panel and LEB light Control panel.
- 6.2.5.2.5.2 Set/Verify the following switches on the PSAAM.
- PSAAM POWER to ON
 - INHIBIT VOLTAGE FAIL to OFF.
- 6.2.5.2.6 Disregard all alarm indications on the CMC DSKY panels. Enter VERB 36 into K148. Press ENTER pushbutton. Press ERROR RESET pushbutton on K-Start. All computer alarms except the Gimbal Lock Indicator on the Main Display Console (MDC) and LEB AGC DSKY shall clear. Verify registers R1, R2, and R3 on the DSKY's are cleared.
- 6.2.5.2.7 Clear the CMC erasable memory by entering the following sequence into the K-Start.
- VERB 47, press ENTER
 - 00015, press ENTER
- 6.2.5.2.8 Initiate CMC Self-Test by entering the following into the K-Start:
- VERB 21 NOUN 27, ENTER
 - 77777, ENTER
 - VERB 15 NOUN 01, ENTER
 - 01366, ENTER
- 6.2.5.2.8.1 Monitor DSKY until R3 (SCOUNT+2) increments twice. If an error is detected, the following will be displayed:
- VERB 05 NOUN 31
 - R1 = 01102
 - R2 = XXXXX c (SFAIL)
 - R3 = XXXXX c (ERCOUNT)
- 6.2.5.2.8.2 Terminate Self-Test by entering the following into the K-Start:
- VERB 21 NOUN 27, ENTER
 - 40000, ENTER

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NOTE: Allow 2 hours to elapse before proceeding to 6.2.5.2.9 with the following exceptions:

- a. If the G&N System has been in the power off state for less than 5 days with the gimbals in the parked position (0°, 0°, 90°) and the system has not been moved, allow 15 minutes to elapse before proceeding.
- b. If the G&N System has been turned off with the gimbals in the unparked position for less than 2 hours allow a warmup time equal to the time off but not less than 15 minutes to elapse before proceeding.

CAUTION: If the requirements of 6.2.5.2.10 are not met, remove IMU Operate Power immediately by setting the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

6.2.5.2.9

After the required warmup time has elapsed set the G&N IMU MN A and MN B circuit breaker on the Right Hand circuit breaker panel to ON (breaker pushed in), and the G/N POWER - IMU switch on the LEB Lighting Control panel to the ON position (toggle up).

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- b. 23.3 - CC.C = DD.D hours
c. Add DD.D to the time of day recorded in 6.2.6.1.1. This is the time of day at which the high order scalar, channel 03, will overflow.

Do not enter the G&N Operational test within -0.2 hours of the time of day calculated in step 6.2.6.1.3c. If the test is in process at this time, unacceptable test results will occur.

6.2.6.2 Initiation

6.2.6.2.1 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.6.2.2 Enter 00004 into K148. Press the ENTER pushbutton.

6.2.6.2.3 Verify that the PROGRAM display on the CRT indicates 07.

Enter VERB 34 into K148 and press the ENTER pushbutton.

NOTE: During this portion of the test the G&N System is energized through its modes. Any failures will be indicated by the PROGRAM ALARM lamp on the DSKY's lighting with VERB 06 NOUN 31 and R1 = 01411 displayed.

6.2.6.2.4 After approximately 12 minutes, VERB 06, NOUN 06 will flash and the value of the gravity vector in cm/sec^2 shall be displayed in R1 and R2 on the CRT. Record these values.

6.2.6.2.5 R1 contains the first five digits of the gravity vector and R2 contains the last five digits. A decimal point shall be between them. The value for the gravity vector shall be $980.00000 \pm 05.00000 \text{ cm/sec}^2$.

6.2.6.2.6 Enter VERB 33 into K148. Press the ENTER pushbutton.

6.2.6.2.7 When VERB 06 NOUN 06 flashes the value of the horizontal earth rate shall be displayed on R1 and R2 on the CRT. Record these values.

6.2.6.2.8 R1 contains the first five digits of earth rate and R2 contains the last five digits. A decimal point shall be placed between them. R1 shall always be 00000. The horizontal earth rate shall be 00000.83000 ± 0.1000 earth rate units.

6.2.6.3 Test Termination

6.2.6.3.1 Enter VERB 36 into K148. Press the ENTER pushbutton.

6.2.6.3.2 Enter VERB 41, NOUN 20 into K148. Press the ENTER pushbutton.

6.2.6.3.3 Enter +00000 into K148 three times. Press the ENTER pushbutton after each entry.

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6.2.7 Gimbal Friction Test

6.2.7.1 Perform Master Initialization, 6.2.5.3, before proceeding.

6.2.7.2 Inner Gimbal Friction Test

6.2.7.2.1 Set up the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

- a. CG 2120 IG TORQUE MOTOR CURRENT
- b. CG 2117 IGA SERVO ERROR IN PHASE
- c. CG 2112 IG 1X RESOLVER OUTPUT SIN
- d. CG 2113 IG 1X RESOLVER OUTPUT COS
- e. CG 2220 IGA CDU FINE ERROR

6.2.7.2.2 Enter the following into K148.

- a. VERB 01 NOUN 01, ENTER
 - b. 00362, ENTER
- Record R1 = XXXXY

6.2.7.2.3 Enter the following into K148.

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table 1 and XXXX is that recorded in 6.2.7.2.2.

TABLE I

Y (From 6.2.7.2.2)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.7.2.4 Enter the following sequence into the K-Start, pushing the ENTER pushbutton after each entry (+360 IG torquing).

- a. VERB 24 NOUN 01, ENTER
- b. 00407, ENTER
- c. 40000, ENTER
- d. 40034, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

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- 6.2.7.2.5 Enter the following sequence into K-Start:
- VERB 42, press ENTER
 - VERB 33, press ENTER (verify VERB 33 on CRT)
- 6.2.7.2.6 Start analog recorders.
- 6.2.7.2.7 Observe measurement CG 2112, IG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.
- 6.2.7.2.8 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.
- VERB 40, NOUN 20, press ENTER
 - VERB 41, NOUN 20, press ENTER
 - +00000, press ENTER
 - +00000, press ENTER
 - +00000, press ENTER
- 6.2.7.2.9 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 30 seconds before proceeding.
- 6.2.7.2.10 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (-360° IG torquing):
- VERB 24 NOUN 01 ENTER
 - 00407, ENTER
 - 37777, ENTER
 - 37743, ENTER
- Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.
- 6.2.7.2.11 Enter the following sequence into K-Start:
- VERB 42, press ENTER
 - VERB 33, press ENTER (Verify VERB 33 on CRT).
- 6.2.7.2.12 Start analog recorders.
- 6.2.7.2.13 Observe measurement CG 2112, IG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.
- 6.2.7.2.14 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.
- VERB 40, NOUN 20, press ENTER
 - VERB 41, NOUN 20, press ENTER
 - +00000, press ENTER
 - +00000, press ENTER
 - +00000, press ENTER
- 6.2.7.2.15 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 30 seconds before proceeding.

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6.2.7.3 Outer Gimbal Friction Test

6.2.7.3.1 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

- | | | |
|----|---------|---------------------------|
| a. | CG 2180 | OG TORQUE MOTOR CURRENT |
| b. | CG 2177 | OGA SERVO ERROR IN PHASE |
| c. | CG 2172 | OG 1X RESOLVER OUTPUT SIN |
| d. | CG 2173 | OG 1X RESOLVER OUTPUT COS |
| e. | CG 2280 | OGA CDU FINE ERROR |
| f. | CG 2170 | OG 1X RESOLVER OUTPUT TAN |
| g. | CG 2171 | OG 1X RESOLVER OUTPUT SEC |
| h. | CG 2172 | OG 1X RESOLVER OUTPUT SIN |

6.2.7.3.2 Enter the following sequence into the K-Start. Pushing the ENTER pushbutton after each entry (+360° OG torquing):

- VERB 24 NOUN 01, ENTER
- 00405, ENTER
- 40000, ENTER
- 40034, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.3.3 Enter the following sequence into K-Start:

- VERB 42, press ENTER
- VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.3.4 Start analog recorders

6.2.7.3.5 Observe measurement CG 2172, OG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.

6.2.7.3.6 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start:

- VERB 40, NOUN 20, press ENTER
- VERB 41, NOUN 20, press ENTER
- +00000, press ENTER
- +00000, press ENTER
- +00000, press ENTER

6.2.7.3.7 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 30 seconds before proceeding.

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6.2.7.3.8 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (=360° OG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00405, ENTER
- c. 37777, ENTER
- d. 37743, ENTER

Verify on the CRT that (a) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.3.9 Enter the following sequence into K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (verify VERB 33 on CRT).

6.2.7.3.10 Start analog recorders.

6.2.7.3.11 Observe measurement OG 2172, OG 1X resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorder.

6.2.7.3.12 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 40, NOUN 20, press ENTER
- b. VERB 41, NOUN 20, press ENTER
- c. +00000, press ENTER
- d. +00000, press ENTER
- e. -06750, press ENTER

6.2.7.3.13 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = -06750, Wait 30 seconds before proceeding.

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6.2.7.4 Middle Gimbal Friction Test

6.2.7.4.1 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

- a. CG 2150 MG TORQUE MOTOR CURRENT
- b. CG 2147 MGA SERVO ERROR IN PHASE
- c. CG 2142 MG LX RESOLVER OUTPUT SIN
- d. CG 2143 MG LX RESOLVER OUTPUT COS
- e. CG 2250 MGA CDU FINE ERROR
- f. CG 2101
- g. CG 2102
- h. CG 2103
- i. CG 2104
- j. CG 2105
- k. CG 2106
- l. CG 2107
- m. CG 2108
- n. CG 2109
- o. CG 2110
- p. CG 2111
- q. CG 2112
- r. CG 2113
- s. CG 2114
- t. CG 2115
- u. CG 2116
- v. CG 2117
- w. CG 2118
- x. CG 2119
- y. CG 2120
- z. CG 2121
- aa. CG 2122
- ab. CG 2123
- ac. CG 2124
- ad. CG 2125
- ae. CG 2126
- af. CG 2127
- ag. CG 2128
- ah. CG 2129
- ai. CG 2130
- aj. CG 2131
- ak. CG 2132
- al. CG 2133
- am. CG 2134
- an. CG 2135
- ao. CG 2136
- ap. CG 2137
- aq. CG 2138
- ar. CG 2139
- as. CG 2140
- at. CG 2141
- au. CG 2142
- av. CG 2143
- aw. CG 2144
- ax. CG 2145
- ay. CG 2146
- az. CG 2147
- ba. CG 2148
- bb. CG 2149
- bc. CG 2150
- bd. CG 2151
- be. CG 2152
- bf. CG 2153
- bg. CG 2154
- bh. CG 2155
- bi. CG 2156
- bj. CG 2157
- bk. CG 2158
- bl. CG 2159
- bm. CG 2160
- bn. CG 2161
- bo. CG 2162
- bp. CG 2163
- bq. CG 2164
- br. CG 2165
- bs. CG 2166
- bt. CG 2167
- bu. CG 2168
- bv. CG 2169
- bw. CG 2170
- bx. CG 2171
- by. CG 2172
- bz. CG 2173
- ca. CG 2174
- cb. CG 2175
- cc. CG 2176
- cd. CG 2177
- ce. CG 2178
- cf. CG 2179
- cg. CG 2180
- ch. CG 2181
- ci. CG 2182
- cj. CG 2183
- ck. CG 2184
- cl. CG 2185
- cm. CG 2186
- cn. CG 2187
- co. CG 2188
- cp. CG 2189
- cq. CG 2190
- cr. CG 2191
- cs. CG 2192
- ct. CG 2193
- cu. CG 2194
- cv. CG 2195
- cw. CG 2196
- cx. CG 2197
- cy. CG 2198
- cz. CG 2199
- da. CG 2200
- db. CG 2201
- dc. CG 2202
- dd. CG 2203
- de. CG 2204
- df. CG 2205
- dg. CG 2206
- dh. CG 2207
- di. CG 2208
- dj. CG 2209
- dk. CG 2210
- dl. CG 2211
- dm. CG 2212
- dn. CG 2213
- do. CG 2214
- dp. CG 2215
- dq. CG 2216
- dr. CG 2217
- ds. CG 2218
- dt. CG 2219
- du. CG 2220
- dv. CG 2221
- dw. CG 2222
- dx. CG 2223
- dy. CG 2224
- dz. CG 2225
- ea. CG 2226
- eb. CG 2227
- ec. CG 2228
- ed. CG 2229
- ee. CG 2230
- ef. CG 2231
- eg. CG 2232
- eh. CG 2233
- ei. CG 2234
- ej. CG 2235
- ek. CG 2236
- el. CG 2237
- em. CG 2238
- en. CG 2239
- eo. CG 2240
- ep. CG 2241
- eq. CG 2242
- er. CG 2243
- es. CG 2244
- et. CG 2245
- eu. CG 2246
- ev. CG 2247
- ew. CG 2248
- ex. CG 2249
- ey. CG 2250
- ez. CG 2251
- fa. CG 2252
- fb. CG 2253
- fc. CG 2254
- fd. CG 2255
- fe. CG 2256
- ff. CG 2257
- fg. CG 2258
- fh. CG 2259
- fi. CG 2260
- fj. CG 2261
- fk. CG 2262
- fl. CG 2263
- fm. CG 2264
- fn. CG 2265
- fo. CG 2266
- fp. CG 2267
- fq. CG 2268
- fr. CG 2269
- fs. CG 2270
- ft. CG 2271
- fu. CG 2272
- fv. CG 2273
- fw. CG 2274
- fx. CG 2275
- fy. CG 2276
- fz. CG 2277
- ga. CG 2278
- gb. CG 2279
- gc. CG 2280
- gd. CG 2281
- ge. CG 2282
- gf. CG 2283
- gg. CG 2284
- gh. CG 2285
- gi. CG 2286
- gj. CG 2287
- gk. CG 2288
- gl. CG 2289
- gm. CG 2290
- gn. CG 2291
- go. CG 2292
- gp. CG 2293
- gq. CG 2294
- gr. CG 2295
- gs. CG 2296
- gt. CG 2297
- gu. CG 2298
- gv. CG 2299
- gw. CG 2300
- gx. CG 2301
- gy. CG 2302
- gz. CG 2303
- ha. CG 2304
- hb. CG 2305
- hc. CG 2306
- hd. CG 2307
- he. CG 2308
- hf. CG 2309
- hg. CG 2310
- hh. CG 2311
- hi. CG 2312
- hj. CG 2313
- hk. CG 2314
- hl. CG 2315
- hm. CG 2316
- hn. CG 2317
- ho. CG 2318
- hp. CG 2319
- hq. CG 2320
- hr. CG 2321
- hs. CG 2322
- ht. CG 2323
- hu. CG 2324
- hv. CG 2325
- hw. CG 2326
- hx. CG 2327
- hy. CG 2328
- hz. CG 2329
- ia. CG 2330
- ib. CG 2331
- ic. CG 2332
- id. CG 2333
- ie. CG 2334
- if. CG 2335
- ig. CG 2336
- ih. CG 2337
- ii. CG 2338
- ij. CG 2339
- ik. CG 2340
- il. CG 2341
- im. CG 2342
- in. CG 2343
- io. CG 2344
- ip. CG 2345
- iq. CG 2346
- ir. CG 2347
- is. CG 2348
- it. CG 2349
- iu. CG 2350
- iv. CG 2351
- iw. CG 2352
- ix. CG 2353
- iy. CG 2354
- iz. CG 2355
- ja. CG 2356
- jb. CG 2357
- jc. CG 2358
- jd. CG 2359
- je. CG 2360
- jf. CG 2361
- jg. CG 2362
- jh. CG 2363
- ji. CG 2364
- jj. CG 2365
- jk. CG 2366
- jl. CG 2367
- jm. CG 2368
- jn. CG 2369
- jo. CG 2370
- jp. CG 2371
- jq. CG 2372
- jr. CG 2373
- js. CG 2374
- jt. CG 2375
- ju. CG 2376
- jv. CG 2377
- jw. CG 2378
- jx. CG 2379
- iy. CG 2380
- iz. CG 2381
- ka. CG 2382
- kb. CG 2383
- kc. CG 2384
- kd. CG 2385
- ke. CG 2386
- kf. CG 2387
- kg. CG 2388
- kh. CG 2389
- ki. CG 2390
- kj. CG 2391
- kk. CG 2392
- kl. CG 2393
- km. CG 2394
- kn. CG 2395
- ko. CG 2396
- kp. CG 2397
- kq. CG 2398
- kr. CG 2399
- ks. CG 2400
- kt. CG 2401
- ku. CG 2402
- kv. CG 2403
- kx. CG 2404
- ky. CG 2405
- kz. CG 2406
- la. CG 2407
- lb. CG 2408
- lc. CG 2409
- ld. CG 2410
- le. CG 2411
- lf. CG 2412
- lg. CG 2413
- lh. CG 2414
- li. CG 2415
- lj. CG 2416
- lk. CG 2417
- ll. CG 2418
- lm. CG 2419
- ln. CG 2420
- lo. CG 2421
- lp. CG 2422
- lq. CG 2423
- lr. CG 2424
- ls. CG 2425
- lt. CG 2426
- lu. CG 2427
- lv. CG 2428
- lw. CG 2429
- lx. CG 2430
- ly. CG 2431
- lz. CG 2432
- ma. CG 2433
- mb. CG 2434
- mc. CG 2435
- md. CG 2436
- me. CG 2437
- mf. CG 2438
- mg. CG 2439
- mh. CG 2440
- mi. CG 2441
- mj. CG 2442
- mk. CG 2443
- ml. CG 2444
- mn. CG 2445
- mo. CG 2446
- mp. CG 2447
- mq. CG 2448
- mr. CG 2449
- ms. CG 2450
- mt. CG 2451
- mu. CG 2452
- mv. CG 2453
- mw. CG 2454
- mx. CG 2455
- my. CG 2456
- mz. CG 2457
- na. CG 2458
- nb. CG 2459
- nc. CG 2460
- nd. CG 2461
- ne. CG 2462
- nf. CG 2463
- ng. CG 2464
- nh. CG 2465
- ni. CG 2466
- nj. CG 2467
- nk. CG 2468
- nl. CG 2469
- no. CG 2470
- np. CG 2471
- nq. CG 2472
- nr. CG 2473
- ns. CG 2474
- nt. CG 2475
- nu. CG 2476
- nv. CG 2477
- nw. CG 2478
- nx. CG 2479
- ny. CG 2480
- nz. CG 2481
- oa. CG 2482
- ob. CG 2483
- oc. CG 2484
- od. CG 2485
- oe. CG 2486
- of. CG 2487
- og. CG 2488
- oh. CG 2489
- oi. CG 2490
- oj. CG 2491
- ok. CG 2492
- ol. CG 2493
- om. CG 2494
- on. CG 2495
- oo. CG 2496
- op. CG 2497
- oq. CG 2498
- or. CG 2499
- os. CG 2500
- ot. CG 2501
- ou. CG 2502
- ov. CG 2503
- ow. CG 2504
- ox. CG 2505
- oy. CG 2506
- oz. CG 2507
- pa. CG 2508
- pb. CG 2509
- pc. CG 2510
- pd. CG 2511
- pe. CG 2512
- pf. CG 2513
- pg. CG 2514
- ph. CG 2515
- pi. CG 2516
- pj. CG 2517
- pk. CG 2518
- pl. CG 2519
- pm. CG 2520
- pn. CG 2521
- po. CG 2522
- pp. CG 2523
- pq. CG 2524
- pr. CG 2525
- ps. CG 2526
- pt. CG 2527
- pu. CG 2528
- pv. CG 2529
- pw. CG 2530
- px. CG 2531
- py. CG 2532
- pz. CG 2533
- qa. CG 2534
- qb. CG 2535
- qc. CG 2536
- qd. CG 2537
- qe. CG 2538
- qf. CG 2539
- qg. CG 2540
- qh. CG 2541
- qi. CG 2542
- qj. CG 2543
- qk. CG 2544
- ql. CG 2545
- qm. CG 2546
- qn. CG 2547
- qo. CG 2548
- qp. CG 2549
- qq. CG 2550
- qr. CG 2551
- qs. CG 2552
- qt. CG 2553
- qu. CG 2554
- qv. CG 2555
- qw. CG 2556
- qx. CG 2557
- qy. CG 2558
- qz. CG 2559
- ra. CG 2560
- rb. CG 2561
- rc. CG 2562
- rd. CG 2563
- re. CG 2564
- rf. CG 2565
- rg. CG 2566
- rh. CG 2567
- ri. CG 2568
- rj. CG 2569
- rk. CG 2570
- rl. CG 2571
- rm. CG 2572
- rn. CG 2573
- ro. CG 2574
- rp. CG 2575
- rq. CG 2576
- rr. CG 2577
- rs. CG 2578
- rt. CG 2579
- ru. CG 2580
- rv. CG 2581
- rw. CG 2582
- rx. CG 2583
- ry. CG 2584
- rz. CG 2585
- sa. CG 2586
- sb. CG 2587
- sc. CG 2588
- sd. CG 2589
- se. CG 2590
- sf. CG 2591
- sg. CG 2592
- sh. CG 2593
- si. CG 2594
- sj. CG 2595
- sk. CG 2596
- sl. CG 2597
- sm. CG 2598
- sn. CG 2599
- so. CG 2600
- sp. CG 2601
- sq. CG 2602
- sr. CG 2603
- ss. CG 2604
- st. CG 2605
- su. CG 2606
- sv. CG 2607
- sw. CG 2608
- sx. CG 2609
- sy. CG 2610
- sz. CG 2611
- ta. CG 2612
- tb. CG 2613
- tc. CG 2614
- td. CG 2615
- te. CG 2616
- tf. CG 2617
- tg. CG 2618
- th. CG 2619
- ti. CG 2620
- tj. CG 2621
- tk. CG 2622
- tl. CG 2623
- tm. CG 2624
- tn. CG 2625
- to. CG 2626
- tp. CG 2627
- tq. CG 2628
- tr. CG 2629
- ts. CG 2630
- tt. CG 2631
- tu. CG 2632
- tv. CG 2633
- tw. CG 2634
- tx. CG 2635
- ty. CG 2636
- tz. CG 2637
- ua. CG 2638
- ub. CG 2639
- uc. CG 2640
- ud. CG 2641
- ue. CG 2642
- uf. CG 2643
- ug. CG 2644
- uh. CG 2645
- ui. CG 2646
- uj. CG 2647
- uk. CG 2648
- ul. CG 2649
- um. CG 2650
- un. CG 2651
- uo. CG 2652
- up. CG 2653
- uq. CG 2654
- ur. CG 2655
- us. CG 2656
- ut. CG 2657
- uu. CG 2658
- uv. CG 2659
- uw. CG 2660
- ux. CG 2661
- uy. CG 2662
- uz. CG 2663
- va. CG 2664
- vb. CG 2665
- vc. CG 2666
- vd. CG 2667
- ve. CG 2668
- vf. CG 2669
- vg. CG 2670
- vh. CG 2671
- vi. CG 2672
- vj. CG 2673
- vk. CG 2674
- vl. CG 2675
- vm. CG 2676
- vn. CG 2677
- vo. CG 2678
- vp. CG 2679
- vq. CG 2680
- vr. CG 2681
- vs. CG 2682
- vt. CG 2683
- vu. CG 2684
- vv. CG 2685
- vw. CG 2686
- vx. CG 2687
- vy. CG 2688
- vz. CG 2689
- wa. CG 2690
- wb. CG 2691
- wc. CG 2692
- wd. CG 2693
- we. CG 2694
- wf. CG 2695
- wg. CG 2696
- wh. CG 2697
- wi. CG 2698
- wj. CG 2699
- wk. CG 2700
- wl. CG 2701
- wm. CG 2702
- wn. CG 2703
- wo. CG 2704
- wp. CG 2705
- wq. CG 2706
- wr. CG 2707
- ws. CG 2708
- wt. CG 2709
- wu. CG 2710
- wv. CG 2711
- ww. CG 2712
- wx. CG 2713
- wy. CG 2714
- wz. CG 2715
- xa. CG 2716
- xb. CG 2717
- xc. CG 2718
- xd. CG 2719
- xe. CG 2720
- xf. CG 2721
- xg. CG 2722
- xh. CG 2723
- xi. CG 2724
- xj. CG 2725
- xk. CG 2726
- xl. CG 2727
- xm. CG 2728
- xn. CG 2729
- xo. CG 2730
- xp. CG 2731
- xq. CG 2732
- xr. CG 2733
- xs. CG 2734
- xt. CG 2735
- xu. CG 2736
- xv. CG 2737
- xw. CG 2738
- xx. CG 2739
- xy. CG 2740
- xz. CG 2741
- ya. CG 2742
- yb. CG 2743
- yc. CG 2744
- yd. CG 2745
- ye. CG 2746
- yf. CG 2747
- yg. CG 2748
- yh. CG 2749
- yi. CG 2750
- yj. CG 2751
- yk. CG 2752
- yl. CG 2753
- ym. CG 2754
- yn. CG 2755
- yo. CG 2756
- yp. CG 2757
- yq. CG 2758
- yr. CG 2759
- ys. CG 2760
- yt. CG 2761
- yu. CG 2762
- yv. CG 2763
- yw. CG 2764
- yx. CG 2765
- yy. CG 2766
- yz. CG 2767
- za. CG 2768
- zb. CG 2769
- zc. CG 2770
- zd. CG 2771
- ze. CG 2772
- zf. CG 2773
- zg. CG 2774
- zh. CG 2775
- zi. CG 2776
- zj. CG 2777
- zk. CG 2778
- zl. CG 2779
- zm. CG 2780
- zn. CG 2781
- zo. CG 2782
- zp. CG 2783
- zq. CG 2784
- zr. CG 2785
- zs. CG 2786
- zt. CG 2787
- zu. CG 2788
- zv. CG 2789
- zw. CG 2790
- zx. CG 2791
- zy. CG 2792
- zz. CG 2793

6.2.7.4.2 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (+135° MG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00411, ENTER
- c. 63777, ENTER
- d. 77777, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.4.3 Enter the following sequence in the K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.4.4 Start the analog recorder.

6.2.7.4.5 Observe measurement CG 2142, MG LX Resolver output SIN, on the analog recorder. When steady-state condition occurs (approximately 5 minutes), stop the recorder.

6.2.7.4.6 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start:

- a. VERB 40 NOUN 01, ENTER
- b. VERB 41 NOUN 20, press ENTER
- c. +00000, press ENTER
- d. +00000, press ENTER
- e. +06750, press ENTER

6.2.7.4.8 Enter the following sequence into the K-Start. Push ENTER pushbutton after each entry (-135° MG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00411, ENTER
- c. 14000, ENTER
- d. 00000, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

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- 6.2.7.4.9 Enter the following sequence in the K-Start:
- VERB 42, press ENTER
 - VERB 33, press ENTER (Verify VERB 33 on CRT)
- 6.2.7.4.10 Start analog recorders.
- 6.2.7.4.11 Observe measurement CG 2142, MG 1X Resolver output SIN, on the analog recorder. When the steady-state condition occurs, stop the (approximately 5 minutes), stop the recorders, stop the recorder.
- 6.2.7.4.12 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.
- VERB 36, ENTER
 - VERB 40 NOUN 20, press ENTER
 - VERB 41 NOUN 20, press ENTER
 - +00000, press ENTER
 - +00000, press ENTER
 - +00000, press ENTER
- 6.2.7.5 Examine the traces of the recorded measurements for all six phases of this test to detect any sharp discontinuities. Disregard transients of 0.5 second duration or less on the Gimbal Torque motor current traces, and those less than 0.2 second on the CDU fine error measurement traces. The Gimbal Torque motor currents shall not exceed 0.125 ampere. The CDU Fine Error measurements shall not exceed ± 70 mvrms.

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- 3.1.9 Semi-Automatic Moding Check
- 6.2.9 Semi-Automatic Moding Check interrupted. If system open the test is terminated before proceeding with this test.
- 6.2.9.1 Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.9.1.1 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG1530) is $+28.0 \pm 3.0$ VDC. Record the indication on the CRT. Verify that OPTX 28V 800 cps 1% Oph (CG1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.
- 6.2.9.1.2 Enter VERB 67 into K148. Press the ENTER pushbutton.
- 6.2.9.1.3 Enter 00010 into K148. Press the ENTER pushbutton.
- 6.2.9.1.4 Observe VERB 06 NOUN 01 flashes on the CRT and the PROGRAM display indicates 07.
- 6.2.9.2 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 30 seconds the following data shall be displayed on the CRT.
- VERB 06 NOUN 02 flashing
 - $R1 = +00000 \pm 00007$
 - $R2 = +00000 \pm 00007$
 - $R3 = +00000 \pm 00007$
 - IG angle = 000 ± 1 deg.
 - MG angle = 000 ± 1 deg.
 - OG angle = 000 ± 1 deg.
- 6.2.9.3 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.
- VERB 06 NOUN 03 flashing
 - $R1 = +04500 \pm 00007$
 - $R2 = +04500 \pm 00007$
 - $R3 = +04500 \pm 00007$
 - IG angle = 045 ± 1 deg.
 - MG angle = 045 ± 1 deg.
 - OG angle = 045 ± 1 deg.
- 6.2.9.4 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall extinguish. After approximately 100 seconds the following data shall be displayed on the CRT.
- VERB 05 NOUN 30 flashing
 - $R1 = 00000 \pm 00003$
 - $R2 = 00000 \pm 00003$
 - $R3 = 00000 \pm 00003$

NOTE: Negative numbers will be displayed in octal complement form, i.e., -00001 = 77776.

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6.2.9.5 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 05 flashing
- b. R1 = +07100±00007
- c. R2 = +07100±00007
- d. R3 = +07100±00007
- e. IG angle = 071±1 deg.
- f. MG angle = 071±1 deg.
- g. OG angle = 071±1 deg.

The GIMBAL LOCK lamps on the DSKY's shall light. The PGNS caution lamp on the Indicator Control Panel shall light.

6.2.9.6 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 06 flashing
- b. R1 = +09000±00007
- c. R2 = +09000±00007
- d. R3 = +09000±00007
- e. IG angle = 090±1 deg.
- f. MG angle = 090±1 deg.
- g. OG angle = 090±1 deg.

6.2.9.7 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 07
- b. R1 = +13500±00007
- c. R2 = +13500±00007
- d. R3 = +13500±00007
- e. IG angle = 135±1 deg.
- f. MG angle = 135±1 deg.
- g. OG angle = 135±1 deg.

6.2.9.8 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds VERB 06 NOUN 10 shall flash. The GIMBAL LOCK lamp shall extinguish on the DSKY's. The PGNS caution lamp on the Indicator Control Panel shall extinguish.

6.2.9.9 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall extinguish. After approximately 100 seconds the following data shall be displayed on the CRT.

- a. VERB 05 NOUN 30 flashing
- b. R1 = 00000±00003
- c. R2 = 00000±00003
- d. R3 = 00000±00003

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6.2.9.10 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 12 flashing
- b. $R1 = +22500 \pm 00007$
- c. $R2 = +22500 \pm 00007$
- d. $R3 = +22500 \pm 00007$
- e. IG angle = 225 ± 1 deg.
- f. MG angle = 225 ± 1 deg.
- g. OG angle = 225 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY's shall light. The PGNS caution lamp on the Indicator Control Panel shall light.

6.2.9.11 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 13 flashing
- b. $R1 = +22500 \pm 00007$
- c. $R2 = +22500 \pm 00007$
- d. $R3 = +31500 \pm 00007$
- e. IG angle = 225 ± 1 deg.
- f. OG angle = 225 ± 1 deg.
- g. MG angle = 315 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY shall extinguish. The PGNS caution lamp on the Indicator Control Panel shall extinguish.

6.2.9.12 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall extinguish. After approximately 100 seconds the following data shall be displayed on the CRT.

- a. VERB 05 NOUN 30 flashing
- b. $R1 = 00000 \pm 00003$
- c. $R2 = 00000 \pm 00003$
- d. $R3 = 00000 \pm 00003$

6.2.9.13 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 15 flashing
- b. $R1 = +31500 \pm 00007$
- c. $R2 = +31500 \pm 00007$
- d. $R3 = +31500 \pm 00007$
- e. IG angle = 315 ± 1 deg.
- f. MG angle = 315 ± 1 deg.
- g. OG angle = 315 ± 1 deg.

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- 6.2.9.14 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall extinguish. After approximately 100 seconds the following data shall be displayed on the CRT.
- VERB 05 NOUN 30 flashing
 - R1 = 00000 ± 00003
 - R2 = 00000 ± 00003
 - R3 = 00000 ± 00003
- 6.2.9.15 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 20 seconds the following data shall be displayed on the CRT.
- VERB 06 NOUN 17 flashing
 - R1 = +28900 ± 00007
 - R2 = +28900 ± 00007
 - R3 = +28900 ± 00007
 - IG angle = 315 ± 1 deg.
 - OG angle = 315 ± 1 deg.
 - MG angle = 289 ± 1 deg.
- The GIMBAL LOCK lamp on the DSKY's shall light. The PGNS caution lamp on the Indicator Control Panel shall light.
- 6.2.9.16 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data will be displayed on the CRT.
- VERB 06 NOUN 20 flashing
 - R1 = +00000 ± 00007
 - R2 = +00000 ± 00007
 - R3 = +00000 ± 00007
 - IG angle = 000 ± 1 deg.
 - MG angle = 000 ± 1 deg.
 - OG angle = 000 ± 1 deg.
- The GIMBAL LOCK lamp on the DSKY's shall extinguish. The PGNS caution lamp on the Indicator Control Panel shall extinguish.
- 6.2.9.17 Enter VERB 33 and press the ENTER pushbutton. The COMP ACTY lamp on the DSKY's shall flash for a few seconds. After approximately 15 seconds the following data shall be displayed on the CRT.
- VERB 06 NOUN 66 flashing
 - R1 = 000xx
 - R2 = xxxxx
- The GIMBAL LOCK lamp on the DSKY's shall light. The PGNS caution lamp on the Indicator Control Panel shall light.
- Record R1 and R2 as the Middle Gimbal CDU drive rate.
MG rate = $\frac{R1}{R2}$ °/sec. The Middle Gimbal CDU drive rate shall be 14 ± 2°/sec.

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6.2.9.18 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 66 flashing
- b. R1 = 000xx
- c. R2 = xxxxx

The GIMBAL LOCK lamp on the DSKY's shall extinguish. The PGNS caution lamp on the Indicator Control Panel shall extinguish.

Record R1 and R2 as the Inner Gimbal CDU drive rate.

IG rate = $\frac{R1}{R2}$ * /sec. The Inner Gimbal CDU drive rate shall be 14 ± 2 /sec.

6.2.9.19 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 66 flashing
- b. R1 = 000xx
- c. R2 = xxxxx

Record R1 and R2 as the Outer Gimbal CDU drive rate. OG rate = $\frac{R1}{R2}$.
The Outer Gimbal CDU drive rate shall be 14 ± 2 /sec.

6.2.9.20 Enter VERB 33 into K148. The NO ATT lamp on the DSKY's shall extinguish. Press the ENTER pushbutton. After approximately 20 seconds VERB 21 NOUN 22 shall flash on the CRT. Enter +00100 into K148 three times. Press the ENTER pushbutton after each entry. The NO ATT lamp on the DSKY's shall momentarily light, then extinguish. After approximately 100 seconds VERB 01 NOUN 10 flashing shall be displayed on the CRT. Press the ENTER pushbutton.

Enter 00030 into K148. Press the ENTER pushbutton. Verify R1 = 33xxxx.

The ISS WARNING Lamp on the Indicator Control Panel shall light.

The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be ON.

6.2.9.21 Enter VERB 33 into K148. Press the ENTER pushbutton. ISS WARNING and ISS CDU FAIL shall be OFF. After approximately 20 seconds VERB 21 NOUN 22 shall flash on the CRT. Enter +03375 into K148 three times. Press the ENTER pushbutton after each entry. The NO ATT lamp on the DSKY's shall momentarily light, then extinguish. After approximately 100 seconds VERB 01 NOUN 10 flashing shall be displayed on the CRT. Press the ENTER pushbutton.

Enter 00030 into K148. Press the ENTER pushbutton.

Verify R1 = 33xxxx.

The ISS WARNING lamp on the Indicator Control Panel shall light.

The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be ON.

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- 6.2.9.22 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. VERB 06 NOUN 55 shall flash on the CRT. The ISS WARNING lamp on the Control Indicator Panel shall extinguish. The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be OFF.
- 6.2.9.23 Set the OPTICS MODE switch on the Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to CMC.
- 6.2.9.24 Enter VERB 33 into K-148 and press the ENTER pushbutton. After approximately 25 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 66 flashing
 - b. R1 = 000xx
 - c. R2 = xxxxx
- Record R1 and R2 as the Shaft Optics CDU drive rate.
Shaft rate = $\frac{R1}{R2}$. The Shaft Optics CDU drive rate shall be $7.32 \pm 1.82^\circ/\text{sec}$.
- 6.2.9.25 Enter VERB 33 into K148. Press the ENTER pushbutton. In about 15 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 66
 - b. R1 = 0000x
 - c. R2 = xxxxx
- Record R1 and R2 as the Trunnion Optics CDU drive rate. Trunnion rate = $\frac{R1}{R2}$. The Trunnion Optics CDU drive rate shall be $1.83 \pm 0.50^\circ/\text{sec}$.
- 6.2.9.26 Terminate the Semi-Automatic Moding Check by entering VERB 34 into K148. Observe PROG display on DSKY's is 00. Press the ENTER pushbutton. Set the G&N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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6.2.10 Zero Optics Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2 Turn On procedure before proceeding.

6.2.10.1 Set the G/N POWER - OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $+28.0 \pm 3.0$ VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.10.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.

- a. VERB 41, NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.10.3 Insure that the following switches on the G&N Indicator Control Panel are set as follows:

- a. TELESCOPE TRUNNION to SLAVE TO SXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to HI

6.2.10.4 Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K148. Press the ENTER pushbutton.

6.2.10.5 Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following on R1 and R2 of the D6KY.

- a. R1 = $+000.00 \pm 000.03$ (Shaft Angle)
- b. R2 = $+00.000 \pm 00.006$ (Trunnion LOS Angle)

Return the OPTICS MODE switch to MAN.

6.2.10.6 Set up the Analog Recorder to monitor the following measurements. Use a chart speed of 10 mm/sec.

- a. CG 3140 SXT Shaft Tach Output
- b. CG 3155 SXT Trunnion Motor Control Winding
- c. CG 3160 SCT Shaft Tach Output
- d. CG 3170 SCT Trunnion Tach Output

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- 6.2.10.7 Push the Optics Hand Controller to the right, driving the SXT Shaft until R1 on the DSKY indicate $+180 \pm 1^\circ$. Push the Optics Hand Controller up, driving the SXT Trunnion until R2 on the DSKY indicates $+75 \pm 1^\circ$.
- 6.2.10.8 Start the Analog Recorders and set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.
- 6.2.10.9 Monitor the Analog Recorders until all signals return to null. Stop the Analog Recorders. The elapsed time between the initial and final SXT Tach output null shall be less than 15 seconds. The peak magnitude of the SXT Shaft (CG 3140) and Trunnion (CG 3150) tach outputs shall be 3.3 ± 1.3 VRMS. The peak magnitude of the SCT Shaft Tach Output (CG 3160) shall be 3.3 ± 1.3 VRMS. The peak magnitude of the SCT Trunnion Tach Output (CG 3190) shall be 0.85 ± 0.35 VRMS.
- 6.2.10.10 Record R1 and R2 on the CRT. The data displayed shall be as follows:
- a. R1 = 000.00 ± 000.03
 - b. R2 = 00.000 ± 00.006
- Enter VERB 34 and press the ENTER pushbutton.
- 6.2.10.11 Record the Telescope Panel Angle Counter indications. The Shaft Angle shall be 0.0 ± 0.11 degrees. The Trunnion Angle shall be 0.0 ± 0.22 degrees.
- 6.2.10.12 Set the OPTICS MODE switch on the G&N Indicator Control Panel to MAN.

NOTE: If optics testing will not be continued, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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6.2.11 OPTICS Coordinate Transformation Control Test

NOTE: Proceed with this test if 6.2.3 Operate Power on Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding.

6.2.11.1 Set/verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.11.2 Enter the following into the K-Start. Press the ENTER pushbutton after each entry:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.11.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the position indicated.

- a. TELESCOPE TRUNNION to SLAVE TO SXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to HI

6.2.11.4 Set up the analog recorders to monitor the following measurements:

- a. CG 3160 SCT Shaft Tachometer Output
- b. CG 3170 SCT Trunnion Tachometer Output

6.2.11.5 Enter the following into the K-Start to monitor the OPTICS CDU's.

VERB 16 NOUN 55, press ENTER

6.2.11.6 Set the OPTICS MODE switch on the G&N Panel to ZERO. Wait 15 seconds. Insure that the Optics zero properly by observing that R1 and R2 of the CRT indicate as follows:

- a. R1 = +000.00±000.03 (Shaft Angle)
- b. R2 = +00.000±00.006 (Trunnion LOS Angle)

Return the OPTICS MODE switch to MAN.

6.2.11.7 Using the OPTICS CONTROL STICK, drive the Optics until R1 = +225.00 and R2 = +10.000 on the CRT and the DSKY's.

6.2.11.8 Set the CONTROLLER COUPLING switch on the G&N Panel to RSLV and the controller speed switch to MED.

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- 6.2.11.9 Position the movable optics target such that it is centered on the SCT retical pattern, then start the analog recorders at a chart speed of 10 mm/second.
- 6.2.11.10 Quickly displace the OPTICS CONTROL STICK 45 ± 10 degrees in the upper right hand quadrant while sighting on the optics target through the SCT eyepiece. The target shall appear to move in the upper right field of view of the SCT at 45 ± 10 deg. Release the control stick when the target leaves the SCT upper right field of view, and immediately record the shaft angle as displayed on R1 of the CRT and DSKY's. The recorded shaft angle shall be $+225 \pm 10.00$ degrees.
- 6.2.11.11 Enter VERB 34 in the DSKY.
Press the ENTER pushbutton.
- 6.2.11.12 Stop the analog recorder and measure the elapsed time between the initial and the final signal null conditions for the two measurements. The elapsed time shall be 24 ± 6 seconds.
- 6.2.11.13 Set the CONTROLLER COUPLING switch on the G&N Panel to DIRECT and drive the Optics with the OPTICS CONTROL STICK until the shaft and trunnion angles as indicated on the SCT TPAC's are approximately zero. Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN.

NOTE: If Optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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- 6.2.12 Optics Positional Accuracy Test, Proceed with this test if 6.2.3 Operate Power On Test, or 6.2.5.2, Turn-On Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2, Turn On Procedure, before proceeding.
- NOTE: This test requires the use of the G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT StLOS before proceeding. Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.
- 6.2.12.1 Set/verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify the following:
- +28 VDC OPTX OPERATE BUS (CG 1530) is 28.8 ± 3 VDC. Record the indication on the CRT.
 - CG 1211 OPTX 28V 800 cps 1% 0 ph not flashing on CRT.
 - CG 1212 OPTX 800 cps 5% - 90 ph not flashing on CRT.
- 6.2.12.2 Enter the following sequence into the K-Start.
- VERB 41, NOUN 20, ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER
- 6.2.12.3 Insure that OPTICS Optics control switches on the G&N Indicator Control Panel are set as follows:
- OPTICS MODE TO MAN
 - CONTROLLER SPEED to LO
 - CONTROLLER COUPLING to DIRECT
 - TELESCOPE TRUNNION to SLAVE TO SXT
- 6.2.12.4 Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN.
- 6.2.12.5 Resolution Checks
- 6.2.12.5.1 Sight through the SXT eyepiece. Using the OPTIC CONTROL STICK, adjust the SXT to obtain the best reflected field of view of the 5-inch autocollimator reticle engravings at the center of the field of view.

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- 6.2.12.5.2 Note that the autocollimator reticle contains a series of lines of different thickness and width. Each set of lines is marked with a number (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines. The SXT resolution shall be at least 10 arc-seconds at the center of the field of view.
- 6.2.12.5.3 Repeat 6.2.12.5.1 and 6.2.12.5.2 using the SCT and the SCT resolution chart. The SCT shall have a resolution of at least 3 arc-minutes at the center of the field of view.
- 6.2.12.6 Slave Telescope Mode Checks
- 6.2.12.6.1 Enter VERB 16 NOUN 55 into the K-Start, Press the ENTER pushbutton.
- 6.2.12.6.2 Set the OPTICS MODE switch on the Control Indicator Panel to ZERO. After 15 seconds return the OPTICS MODE switch to MAN.
- 6.2.12.6.3 Record the SCT Shaft and Trunnion angles as indicated by the TPAC and the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between the TPAC Shaft angle and the Shaft CDU angle shall be $\pm 0.11^\circ$ or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be $\pm 0.22^\circ$ or less.
- 6.2.12.6.4 Using the OPTICS CONTROL STICK and CONTROLLER SPEED switch, drive the SXT Shaft and Trunnion CDU's until $R1 = +035.00 \pm 0.10$ deg. and $R2 = +35.000 \pm 0.100$ deg. Record R1 and R2. Record the Shaft and Trunnion angles as indicated by the TPAC. The difference between the TPAC Shaft angle and Shaft CDU angle shall be $\pm 0.11^\circ$ or less. The difference between the TPAC Trunnion angle and Trunnion CDU angle shall be $\pm 0.22^\circ$ or less.
- 6.2.12.6.5 Set the OPTICS MODE switch to ZERO. After 15 seconds return the OPTICS MODE switch to MAN.
- 6.2.12.6.6 Set the TELESCOPE TRUNNION switch to the 0° position.

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- 6.2.12.6.7 Remove the plug from the base of the SXT eyepiece and install the Adapter Assembly and Portable Light Assembly. Turn on the light.
NOTE: If needed to reduce external light, place a photographers hood over the optics head and retroreflecting prism.
- 6.2.12.6.8 By sighting through the SCT eyepiece, position the Retroreflecting Prism, Model No. A23-200, to span between the SXT StLOS and SCT LOS such that the illumination from the backlight filament is clearly visible at the center of the field of view.
- 6.2.12.6.9 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Using the OPTICS CONTROL STICK, adjust the trunnion CDU to bring the SCT horizontal reticle line into coincidence with the SXT horizontal reticle line. Record the Trunnion CDU angle displayed in R2 as XX.XXX degrees. The difference between this angle and the corresponding angle recorded in 6.2.12.6.3 shall be $\pm 0.2^\circ$ or less.
- 6.2.12.6.10 Replace the Portable Light in the adapter on the SXT eyepiece.
- 6.2.12.6.11 Set the OPTICS MODE switch to ZERO. After 15 seconds return the OPTICS MODE switch to MAN. Set the TELESCOPE TRUNNION switch to SLAVE TO SXT.
- 6.2.12.6.12 Temporarily disable the SCT TRUNNION electrical drive by carefully unscrewing the SCT TRUNNION Manual Drive until it just releases from the panel. Do not rotate further, as this would displace the SCT LOS from the desired reference position.
- 6.2.12.6.13 Remove the Portable Light from the adapter and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in step 6.2.12.6.9. Again using the OPTICS CONTROL STICK, bring the SCT horizontal reticle line into coincidence with the SXT horizontal reticle. Record the Trunnion CDU angle displayed in R2. The difference between this angle and the corresponding angle measured in 6.2.12.6.3 shall be $\pm 0.2^\circ$ or less. Replace the Portable Light Assembly in the adapter.
- 6.2.12.6.14 Replace the SCT TRUNNION Manual Drive in the panel.
- 6.2.12.6.15 Use the OPTICS CONTROL STICK to drive the Trunnion CDU to $+25.000^\circ \pm 0.006^\circ$ as indicated on R2. Maintain the Shaft CDU at $000.00^\circ \pm 0.01^\circ$ as indicated on R1.
- 6.2.12.6.16 Set the TELESCOPE TRUNNION switch to 25°. After 30 seconds has elapsed, record the TPAC Trunnion angle and Trunnion CDU angle displayed in R2. The difference shall be $\pm 0.22^\circ$ or less. Record the Shaft CDU angle displayed in R1.
- 6.2.12.6.17 Temporarily disable the electrical drive to the SCT Trunnion and SCT Shaft by unscrewing the SCT Trunnion and Shaft Manual Drive items until they just release from the panel. Do not rotate further, as this would displace the SCT LOS from the desired reference position.

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- 6.2.12.6.18 Reposition the Retroreflecting Prism so that it is inclined at an angle of 25° downward and spans the SCT LOS and SXT StLOS. Sight into the SCT and adjust the prism so that illumination from the backlight filament is again visible at the center of the field of view. Remove the Portable Light Assembly from the SXT eyepiece adapter and direct the light into the SCT eyepiece while sighting through the SXT eyepiece. Observe the comparison of SCT and SXT reticles. Adjust the Trunnion CDU and Shaft CDU angles with the OPTICS CONTROL STICK to bring the two reticle patterns into coincidence. Record the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between each of these angles and the respective angles recorded in 6.2.12.6.16 shall be ± 0.2 degrees or less.
- 6.2.12.6.19 Replace the SCT Shaft and Trunnion Manual Drive items. Replace the Portable Light Assembly in the adapter. Set the TELESCOPE TRUNNION switch to SLAVE TO SXT. Set the OPTICS MODE switch to ZERO. Wait 15 seconds and then set the OPTICS MODE to MAN. Remove the Retro-reflecting Prism and photographer's hood if used.
- 6.2.12.7 SXT Parallelism Tests
- 6.2.12.7.1 Using the OPTICS CONTROL STICK drive the SXT StLOS Trunnion to $+15.000^\circ \pm 2^\circ$ as indicated in R2 of the DSKY. Maintain a Shaft CDU angle of 000.00 ± 0.01 degrees.
- 6.2.12.7.2 Sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to superimpose the SXT LLOS horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.
- 6.2.12.7.3 Repeat 6.2.12.7.2 twice. Calculate and record the average of the three autocollimator readings.
- 6.2.12.7.4 Set the OPTICS MODE switch to ZERO. After 15 seconds return the OPTICS MODE switch to MAN.
- 6.2.12.7.5 Again sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to bring the SXT StLOS horizontal reticle and autocollimator horizontal filar images to coincide. Record the autocollimator reading.
- 6.2.12.7.6 Repeat 6.2.12.7.5 twice. Calculate and record the average of the three autocollimator readings. The average value obtained here shall not differ from that obtained in 6.2.12.7.3 by more than 10 arc seconds.
- 6.2.12.7.7 Using the OPTICS CONTROL STICK drive the SXT Trunnion angle to $85.000^\circ \pm 5^\circ$ as indicated on R2 of the DSKY. Set the CONTROLLER SPEED to LO and drive the SXT Trunnion to $+90.000^\circ \pm 0.006^\circ$ as indicated on R2 of the DSKY. Insure that the SXT Shaft angle remains at 000.00 ± 0.02 degrees as indicated by R1 on the DSKY.
- 6.2.12.7.8 Sight through the SXT. Two reticle patterns shall be visible. Use the OPTICS CONTROL STICK to adjust the SXT Trunnion angle until the two horizontal reticle lines are coincident. Record the Trunnion CDU angle displayed in R2. The Trunnion CDU angle shall be 90.000 ± 0.010 degrees.

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- 6.2.12.7.9 Remove the Portable Light Assembly and Adapter Assembly from the base of the SXT eyepiece. Replace the SXT eyepiece plug.
NOTE: If Optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.
- 6.2.12.8 Shaft and Trunnion Positional Accuracy Checks.
- 6.2.12.8.1 Set the OPTICS MODE switch to ZERO. After 15 seconds, return the selector to MANUAL.
- 6.2.12.8.2 Sight through the SXT. Using the control stick align the SXT SLOS with optical target No. 1 on the G&N Installation Fixture Model No. A23-071.
- 6.2.12.8.3 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton. Record the value of R1 and R2 displayed on the CRT. Record the Shaft and Trunnion Angles from the TPAC.
- 6.2.12.8.4 Sight through the SXT. Using the control stick align the SXT SLOS with Optical Target No. 2 on A23-071.
- 6.2.12.8.5 Record the value in R1 and R2 on the CRT. Record the Shaft and Trunnion Angles from the TPAC.
- 6.2.12.8.6 Set the OPTICS MODE switch to ZERO. After 15 seconds set the switch to CMC.
- 6.2.12.8.7 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.8 Enter the value recorded from R1 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.9 Enter the value recorded from R2 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.10 Sight through the SXT. The SLOS should be centered on Optical Target No. 1 on A23-071. Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.3 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.11 Enter VERB 41 NOUN 55 into the K-START. Press the ENTER pushbutton.
- 6.2.12.8.12 Enter the value recorded from R1 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.13 Enter the value recorded from R2 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.

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- 6.2.12.8.14 Sight through the SXT. The SLOS should be centered on Optical Target No. 2 on A23-071. Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.5 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.15 Set the OPTICS MODE switch to ZERO. After 16 seconds return the switch to MANUAL.
- 6.2.12.8.16 Enter VERB 41 NOUN 20 into the K-START. Press the ENTER pushbutton. Enter +00000 into the K-START 3 times. Press the ENTER pushbutton after each entry.

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- Optics Slew Rate Test
- 6.2.13** **Optics Slew Rate Test.** To test if 6.2.3 Operate button On Test has been completed, the system must be in the following state before proceeding. If
- NOTE: Perform Master Initialization 6.2.3.3 before proceeding.** Run the procedures, OCU's processing.
- 6.2.13.1** Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $+28.0 \pm 3.0$ VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.
- 6.2.13.2** Enter the following sequence into K148. Press the ENTER pushbutton after each entry.
- VERB 41 NOUN 20, ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER
- 6.2.13.3** Verify and/or set the following switches on the G&N Indicator Control Panel to the positions indicated.
- TELESCOPE TRUNNION to SLAVE to SXT
 - CONTROLLER COUPLING to DIRECT
 - CONTROLLER SPEED to HI
- 6.2.13.4** Monitor the OCU's by entering VERB 16 NOUN 55 into K148. Press the ENTER pushbutton.
- 6.2.13.5** Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following data displayed in R1 and R2 on the DSKY.
- R1 = $+000.00 \pm 000.03$ (Shaft Angle)
 - R2 = $+00.000 \pm 00.006$ (Trunnion LOS Angle)
- Set the OPTICS MODE switch on the G&N Indicator Panel to MAN.
- NOTE:** Read & understand step 6.2.13.6 before proceeding. Do not hold Control Stick at upper limit more than 10 seconds, or exceed a trunnion angle of 85°
- Trunnion Slew Rate - HI Speed
- 6.2.13.6** Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R2 and R3. The data displayed is in the following form:
- R2 = $\pm XX.XXX$ (Trunnion LOS angle in deg.)
 - R3 = $\pm XXX.XX$ (Time in seconds)

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6.2.13.7 Perform the following calculations:

- a. Difference between R2 displays = $\frac{\Delta \text{ trun. angle}}{\Delta \text{ time}}$ (Δ trun. angle)
 b. Difference between R3 displays = $\frac{\Delta \text{ time}}{\Delta \text{ trun. angle}}$ (Δ time)
 c. $\frac{\Delta \text{ trun. angle}}{\Delta \text{ time}} = \text{deg/sec}$

T

The Trunnion slew rate shall be 10 ± 2 deg/sec.

Shaft Slew Rate - HI Speed

6.2.13.8 Using the Optics Control Stick, drive the Trunnion LOS Angle back to approximately zero degrees as indicated on the TPAC. Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read and understand step 6.2.13.9 before proceeding. Do not hold Control Stick at right limit for more than 10 seconds, or exceed a shaft angle of 250°.

6.2.13.9 Push and hold the Optics Control stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R1 and R3. The data displayed is in the following form.

- R1 = + XXX.XX (Shaft angle in deg.)
 R3 = + XXX.XX (Time in seconds)

6.2.13.10 Perform the following calculations

- a. Difference between R1 displays = $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}}$ (Δ shaft angle)
 b. Difference between R3 displays = $\frac{\Delta \text{ time}}{\Delta \text{ shaft angle}}$ (Δ time)
 c. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \text{deg/sec}$

The Shaft Slew Rate shall be 18.5 ± 3.9 deg/sec.

Trunnion Slew Rate - MED Speed

6.2.13.11 Using the Optics Control Stick, drive the shaft angle back to approximately zero degrees as indicated on the TPAC. Set the OPTICS MODE switch to zero. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to MED.

NOTE: Read & understand 6.2.13.12 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

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6.2.13.12 Push and hold the Optics Control stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 10 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R2 & R3. The data displayed is in the following form:

- a. R2 = ±XX.XXX (Trunnion LOS Angle in degrees)
- b. R3 = +XXX.XX (Time in seconds)

6.2.13.13 Perform the following calculations:

- a. Difference between R2 displays = ____ (Δ Trunnion Angle)
- b. Difference between R3 displays = ____ (Δ Time)

$$\frac{\Delta \text{ Trunnion angle}}{\Delta \text{ Time}} = \text{____ deg./sec}$$

The Trunnion slew rate shall be 1.0 ± 0.3 deg/sec.

Shaft Slew Rate - MED Speed

6.2.13.14 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read & understand 6.2.13.15 before proceeding. Do not hold control stick at right limit for more than 30 seconds.

6.2.13.15 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 10 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R1 and R3. The data displayed is in the following form:

- a. R1 = ± XXX.XX (Shaft Angle in degrees)
- b. R3 = + XXX.XX (Time in seconds)

6.2.13.16 Perform the following calculations

- a. Difference between R1 displays = ____ (Δ Shaft Angle)
- b. Difference between R3 displays = ____ (Δ Time)

$$\frac{\Delta \text{ Shaft Angle}}{\Delta \text{ Time}} = \text{____ deg/sec}$$

The Shaft Slew Rate shall be 2.0 ± 0.4 deg/sec.

Trunnion Slew Rate - LO Speed

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6.2.13.17 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to LO.

NOTE: Read and understand 6.2.13.18 before proceeding. Do not hold control stick at upper limit for more than 30 seconds.

6.2.13.18 Push and hold the Optics Control stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 10 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R2 and R3. The data displayed is in the following form:

- a. R2 = XX.XXX (Trunnion LOS Angle in degrees)
- b. R3 = XXX.XX (Time in seconds)

6.2.13.19 Perform the following calculations:

- a. Difference between R2 displays = XX.XXX { Δ Trunnion Angle }
- b. Difference between R3 displays = XXX.XX { Δ Time }
- c.
$$\frac{\Delta \text{ Trunnion Angle}}{\Delta \text{ Time}} = \text{--- deg/sec}$$

The Trunnion Slew Rate shall be 0.10 ± 0.02 deg/sec.

Shaft Slew Rate - LO Speed

6.2.13.20 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read and understand 6.2.13.21 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.21 Push and hold the Optics Control stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 10 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R1 and R3. The data displayed is in the following form:

- a. R1 = XXX.XX (Shaft Angle in degrees)
- b. R3 = XXX.XX (Time in seconds)

6.2.13.22 Perform the following calculations:

- a. Difference between R1 displays = --- : --- { Δ Shaft Angle }
- b. Difference between R3 displays = --- : --- { Δ Time }
- c.
$$\frac{\Delta \text{ Shaft Angle}}{\Delta \text{ Time}} = \text{--- deg/sec}$$

The Shaft Slew Rate shall be 0.20 ± 0.04 deg/sec.

6.2.13.23 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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- 6.2.14 Stabilization Loop Step Response Test
- 6.2.14.1 Proceed with this test if the Operate Power On Test of 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding.
- 6.2.14.2 Insure that the Carry-on Command Stimuli Unit, Model No. C14-200, is installed and connected.
- 6.2.14.3 Enter VERB 36 into K148. Press the ENTER pushbutton, then the ERROR RESET pushbutton.
- 6.2.14.4 Inner Gimbal Response Test
- 6.2.14.4.1 Enter code 2032000000 in C-START Module 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2117 IGA SERVO ERROR on 4A1-A3-CH1.
- 6.2.14.4.2 Enter VERB 41 NOUN 20 into K148. Press ENTER pushbutton.
- 6.2.14.4.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.
- 6.2.14.4.4 Enter VERB 42 into K148. Press ENTER.
- 6.2.14.4.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.
- 6.2.14.4.6 Enter 0001 into R154. Verify and execute to apply +28 VDC ACE ENABLE to the PSAAM.
- 6.2.14.4.7 Enter 1000 into R155. Verify and execute to enter a DC step into the IG stabilization loop.
- CAUTION: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.
- 6.2.14.4.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.
- 6.2.14.4.9 Enter 0000 into 4A2-A6-R155; the top part of switch should be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the IG Stabilization Loop. The bottom part of switch shall be extinguished.
- 6.2.14.4.10 After the transient has died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step input and the settling of the error signal to a value equal to ± 5 percent of the original step amplitude. In addition, record the total number of overshoots.

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- 6.2.14.7.2 Enter +00000 into K148. Press the ENTER pushbutton.
- 6.2.14.7.3 Enter +00000 into K148. Press the ENTER pushbutton.
- 6.2.14.7.4 Enter +00000 into K148. Press the ENTER pushbutton.

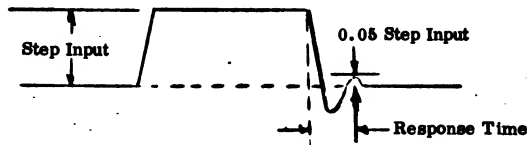


Figure 1. Typical Step Input Response

- 6.2.14.7.5 Enter 0000 into R154. Verify and execute to remove +28 VDC ACE ENABLE.
- 6.2.15 IRIG Scale Factor Test
- 6.2.15.1 Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.15.2 Verify that the IMU OPERATE power has been applied for a minimum of 1 hour, and that at least 1 hour has elapsed since running of the Gimbal Friction Test, 6.2.7.
- 6.2.15.3 Set up the Analog Recorders to monitor the following signals:
- a. CG 2117 IG SERVO ERROR
 - b. CG 2147 MG SERVO ERROR
 - c. CG 2177 OG SERVO ERROR
 - d. CG 2120 IG TM CURRENT
 - e. CG 2150 MG TM CURRENT
 - f. CG 2180 OG TM CURRENT
- 6.2.15.3.1 Start the analog recorder chart drive using a chart speed of 1 mm/sec. The recorder shall run for the duration of 6.2.15.
- 6.2.15.4 Enter VERB 57 into K148. Press the ENTER pushbutton.
- 6.2.15.5 Enter 00005 into K148. Press the ENTER pushbutton.
- 6.2.15.6 VERB 06 NOUN 61 shall flash on CRT and the following displayed in R1 and R2:
- R1 = xxxxxx (some Nav. Base azimuth)
- R2 = xxxxxx (some test site latitude; see Table I)

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- 6.2.15.10 After 160 seconds VERB 06 NOUN 66 shall flash on the CRT. Record the value displayed in register R1 for the appropriate Test Number in Table 2. The data displayed is the Scale Factor error in parts per million. The recorded Scale Factor error shall not exceed ± 1750 ppm.

Table 2. Display of Test Parameters

<u>Test Number</u>	<u>Symbol</u>	<u>Display in R1</u>
-00001	E+X	±XXXXX
+00001	E-X	±XXXXX
-00002	E+Y	±XXXXX
+00002	E-Y	±XXXXX
-00003	E+Z	±XXXXX
+00003	E-Z	±XXXXX

- 6.2.15.11 Enter VERB 33 into K148. Press the ENTER pushbutton.
- 6.2.15.12 Repeat 6.2.15.9 through 6.2.15.11 until all Test Numbers in Table I have been utilized. When the last test number is entered perform only 6.2.15.9 and 6.2.15.10.
- 6.2.15.13 Enter VERB 34 into K148. Press the ENTER pushbutton.
- 6.2.15.13.1 After completion of all test numbers, stop the analog recorders.
- 6.2.15.14 Enter VERB 40 NOUN 20 in K143. Press the ENTER pushbutton.
- 6.2.15.14.1 Enter VERB 41 NOUN 20 into K148. Press the ENTER pushbutton.
- 6.2.15.14.2 Enter +00000 into K148 three times, pressing the ENTER pushbutton after each entry.
- 6.2.16 IMU Performance Test
- 6.2.16.1 Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.16.2 Enter VERB 01 NOUN 10 into K148. Press the ENTER pushbutton. Enter 00003 into K148. Press the ENTER pushbutton. Record R1 = AAAAA and the time of day.
- 6.2.16.3 Enter VERB 21 NOUN 02 into K148. Press the ENTER pushbutton. Enter 01300 into K148. Press ENTER. Enter AAAAA into K148. Press ENTER.
- 6.2.16.4 Enter VERB 06 NOUN 02 into K148. Press ENTER. Enter 01300 into K148. Press ENTER. Record R1 = BBBBB.

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6.2.16.5 Perform the following calculations:

- a. $\frac{R1 (BBBBB) \times 5.12}{3600} = CCCC.C$ (hrs. in high order scalar channel 3)
- b. $23.3 - CCC.C = DDDDD$ Hrs.
- c. Add DDDDD to time of day recorded in step 1.

Do Not enter any of the PIPA scale factor tests within -0.2 hours of the time of day calculated in step 6.2.16.5c. This is the time at which the high order scalar, channel 3, will overflow. If a PIPA scale factor test is being performed at this time, unacceptable test results will occur.

6.2.16.6 Verify that the IMU Operate Power has been applied for at least one hour.

6.2.16.7 Test Initiation.

6.2.16.7.1 Enter the following into K148.

- a. VERB 01 NOUN 01, ENTER
 - b. 00362, ENTER
- Record R1 = XXXXY

6.2.16.7.2 Enter the following into K148

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table XV and XXXX is that recorded in 6.2.16.7.1.

TABLE XV

Y (from 6.2.16.7.1)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.16.7.3 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.16.7.4 Enter 00001 into K148. Press the ENTER pushbutton.

6.2.16.7.5 VERB 06 NOUN 61 shall appear flashing on CRT and will contain the following information:

R1 = ~~XXXX~~ (Some NB Azimuth)
R2 = ~~XXXX~~ (Some Test Site Latitude)

Insure that R1 = Correct NB Azimuth and R2 = Present Test Site Latitude from Table XX.

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6.2.16.7.6 If R1 does not contain the correct NB Azimuth, enter the following sequence into K148.

- a. VERB 21, ENTER
- b. +xxx, xx, ENTER (where +xxxxx is the NB Azimuth)

6.2.16.7.7 If R2 does not contain present Test Site Latitude enter the following sequence into K148:

- a. VERB 22, ENTER
- b. Proper Data from Table XX, ENTER

Table XX

<u>Location</u>	<u>Latitude</u>
NAA	+33.921
MSC	+29.556
MILA	+28.516

6.2.16.7.8 Enter VERB 33 into K148. Press ENTER pushbutton.

6.2.16.7.9 VERB 06 NOUN 66 shall appear flashing on CRT. Verify that the following values appear on CRT.

R1 = +00900
R2 = +00000
R3 = +00001

6.2.16.7.10 If the contents of R1 on the CRT are not +00900, enter the following sequence into K148.

- a. VERB 21, ENTER
- b. +00900, ENTER

6.2.16.7.11 If the contents of R2 on the CRT are not +00000, enter the following sequence into K148:

- a. VERB 22, ENTER
- b. +00000, ENTER

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- 6.2.16.7.12 If the contents of R3 on the CRT are not +00001, enter the following sequence into K148:
- a. VERB 23, ENTER
 - b. +00001, ENTER
- 6.2.16.7.13 Verify correct display in R1, R2, and R3. Enter VERB 33 into K148. Press the ENTER pushbutton.
- 6.2.16.7.14 After approximately 17 minutes, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the value of CRT for R2 on the calculation sheet.
- 6.2.16.7.15 Enter VERB 33 into K148. Press the ENTER pushbutton.
- 6.2.16.7.16 After approximately 90 sec, VERB 06, NOUN 66 shall appear flashing on the CRT. Record the value on CRT for R1 and R2 on the calculation sheet.
- 6.2.16.7.17 Enter VERB 34 into K148. Press the ENTER pushbutton.
- 6.2.16.7.18 Repeat steps 6.2.16.7.9 through 6.2.16.7.16, substituting position number +00002 in R3.
- 6.2.16.7.19 Enter VERB 33 into K148. Press ENTER pushbutton. Record the CRT CDU gimbal angle indications and time.
- 6.2.16.7.20 After approximately 67 minutes, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the CRT CDU gimbal angle, indications and time. Record the value on CRT for R2 on the calculation sheet.
- 6.2.16.7.21 Enter VERB 34, ENTER into K148. Repeat steps 6.2.16.7.9 through 6.2.16.7.17, substituting position number +00003 in R3.
- 6.2.16.7.22 Repeat steps 6.2.16.7.18 through 6.2.16.7.20, substituting position number +00004 in R3.
- 6.2.16.7.23 Enter VERB 34 into K148. Press ENTER pushbutton.

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6.2.16.7.24 VERB 06 NOUN 66 shall flash on the CRT. Verify the following data is also displayed on the CRT.

- a. R1 = +00900
- b. R2 = +00000
- c. R3 = +00005

If data is incorrect perform steps 6.2.16.7.10 thru 6.2.16.7.12 entering the correct data. Enter VERB 33 into K148. Press ENTER pushbutton.

The PROGRAM ALARM and GIMBAL LOCK status lights shall be illuminated on the DSKY.

6.2.16.7.25 Press the RESET pushbutton. The Program Alarm lamp shall extinguish. In approximately 90 sec, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the data displayed in R1 and R2 on the CRT.

6.2.16.7.26 Enter VERB 34 into K148. Press ENTER pushbutton. Repeat steps 6.2.16.7.24 and 6.2.16.7.25 substituting position no. +00006.

6.2.16.7.27 Enter VERB 34 into K148. Press the ENTER pushbutton. VERB 06 NOUN 66 shall flash on the CRT. Verify the following data is also displayed on the CRT.

- a. R1 = +00900
- b. R2 = +00000
- c. R3 = +00007

If the data is incorrect perform steps 6.2.16.7.10 thru 6.2.16.7.12 entering the correct data.

6.2.16.7.28 Enter VERB 33 into K148. Press ENTER pushbutton. The GIMBAL LOCK status lamp shall extinguish. In approximately 17 minutes VERB 06 NOUN 66 shall flash on the CRT. Record the data displayed in R2 of the CRT.

6.2.16.7.29 Repeat steps 6.2.16.7.27 and 6.2.16.7.28 substituting position no. +00008 in R3.

6.2.16.7.30 Repeat steps 6.2.16.7.27 and 6.2.16.7.28 substituting position no. +00009 in R3.

6.2.16.7.31 Repeat steps 6.2.16.7.27 and 6.2.16.7.28 substituting position no. +00010 in R3.

6.2.16.8 To terminate the IMU Performance Test, enter VERB 36 into K148. Press ENTER pushbutton.

6.2.16.9 Enter the following sequence in K148.

- a. VERB 40 NOUN 20, ENTER
- b. VERB 41 NOUN 20, ENTER
- c. +00000, ENTER
- d. +00000, ENTER
- e. +00000, ENTER

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6.2.16.10.1 Measured Values

<u>Line</u>	<u>Position No.</u>	<u>Step No.</u>	<u>Parameter</u>	<u>Recorded Value</u>
6.2.16.10.1.1	1	+00001	6.2.16.7.14 +NBDY	R2
6.2.16.10.1.2	2	+00001	6.2.16.7.16 +XPIPAG	R1 . R2
6.2.16.10.1.3	3	+00002	6.2.16.7.14 +NBDZ	R2
6.2.16.10.1.4	4	+00002	6.2.16.7.16 -XPIPAG	R1 . R2
6.2.16.10.1.5	5	+00002	6.2.16.7.20 -NBDX+ ADIAZ	R2
6.2.16.10.1.6	6	+00003	6.2.16.7.14 -NBDX	R2
6.2.16.10.1.7	7	+00003	6.2.16.7.16 +ZPIPAG	R1 . R2
6.2.16.10.1.8	8	+00004	6.2.16.7.14 +NBDY + ADSRAY	R2
6.2.16.10.1.9	9	+00004	6.2.16.7.16 -ZPIPAG	R1 . R2
6.2.16.10.1.10	10	+00004	6.2.16.7.20 +NBDZ + ADIAZ	R2
6.2.16.10.1.11	11	+00005	6.2.16.7.25 +YPIPAG	R1 . R2
6.2.16.10.1.12	12	+00006	6.2.16.7.25 -YPIPAG	R1 . R2
6.2.16.10.1.13	13	+00007	6.2.16.7.28 -NBDX + .707ADSRAX	R2
6.2.16.10.1.14	14	+00008	6.2.16.7.28 .707 (-NBDZ- NBDY) + .5 (ADIAZ-ADIAZ) +.5 (ADSRAY + ADSRAZ)	R2
6.2.16.10.1.15	15	+00009	6.2.16.7.26 -NBDZ + .707ADSRAX	R2
6.2.16.10.1.16	16	+00010	6.2.16.7.26 .707(NBDY - NBDX) + .5 (ADIAZ - ADIAZ) + .5 ADSRAZ	R2

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- 6.2.17.1** **SXT-NB-IMU Fine Alignment Test:** Perform this test after the SXT-NB-IMU has been aligned and the SXT-NB-IMU has been initialized. It is performed after the SXT-NB-IMU has been initialized.
- 6.2.17.1** **Perform Master Initialization 6.2.5.3 before proceeding.**
- 6.2.17.2** Prior to performing this test, the G&N Installation Qualification fixture shall be installed on the supporting fixture and adjusted to permit proper operation of the G&N optics. The azimuth supplied by the azimuth autotest (Optical Reference No. 1) shall be known to ± 30 minutes of arc.
- NOTE:** The G&N shall have had OPERATE power applied for a minimum of 1 hour. Set the G/N POWER-OPTICS switch to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $+28.0 \pm 3.0$ VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTIX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.
- 6.2.17.3** Enter VERB 01 NOUN 10 into K148. Press the ENTER pushbutton. Enter 00003 into K148. Press the ENTER pushbutton. Record AAAAA and the time of day.
- 6.2.17.4** Enter VERB 21 NOUN 02 into K148. Press the ENTER pushbutton. Enter 01300 into K148. Press the ENTER pushbutton. Enter AAAAA into K148. Press the ENTER pushbutton.
- 6.2.17.5** Enter VERB 06, NOUN 02 into K148. Press ENTER. Enter 01300 into K148. Press ENTER. Record R1 = BBBB.
- 6.2.17.6** Perform the following calculations:
- $\frac{R1 (BBBB) \times 5.12}{3600} = CCCC.C$ (Hrs. in high order scaler channel 3)
 - $23.3 - CCCC.C = DDDDD$ Hrs.
 - Add DDDDD to time of day recorded in step 1.
- DO NOT enter any of the SM Misalignment tests within -0.2 hours of the time of day calculated in step 6.2.17.6c. This is the time at which the high order scaler, channel 3, will overflow. If a SM Misalignment test is being performed at this time, unacceptable test results will occur.
- 6.2.17.7** Enter the following sequence into the Lower Equipment Bay (LEB) DSKY.
- VERB 41 NOUN 20 ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER
- 6.2.17.8** On the G&N Indicator Control Panel set the following switches to the position indicated.
- TELESCOPE TRUNNION to SLAVE to SXT
 - CONTROLLER COUPLING to DIRECT
 - CONTROLLER SPEED to LO
 - OPTICS MODE TO MAN

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6.2.17.9 Enter the following into the DSKY.

- a. VERB 01 NOUN 01, ENTER
- b. 00362, ENTER
- Record R1 = XXXXY

6.2.17.10 Enter the following into the DSKY

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table II and XXXX is that recorded in 6.2.17.9.

TABLE II

Y (From 6.2.17.9)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.17.11 Initiate the test by entering the following sequence into the LEB DSKY.

- a. VERB 57, ENTER
- b. 00003, ENTER

6.2.17.12 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data is displayed in R1 and R2 on the DSKY.

- a. R1 = +13500
- b. R2 = +xx.xxx (Site Latitude from Table I)

TABLE I

Test Site	Latitude
NAA	+33.922
MILA	+28.516
MSC	+29.556

6.2.17.13 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If the value displayed is other than +13500 in R1 and the correct Site Latitude in R2, correct the data by entering the following sequence into the DSKY.

- a. VERB 21, ENTER
- b. +13500, ENTER
- c. VERB 22, ENTER
- d. +xx.xxx, ENTER (+xx.xxx = Site Latitude from Table I)
- e. VERB 33, ENTER

6.2.17.14 Observe VERB 21 NOUN 30 flashing on the DSKY. Enter the following sequence into the DSKY.

- a. +00001, ENTER (Position Number)
- b. +00000, ENTER
- c. +00001, ENTER

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- 6.2.17.15 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- a. R1 = +xxx.xx (Y_{NB} Azimuth)
 - b. R2 = ±xx.xxx (Y_{NB} Elevation)
 - c. R3 = 00001
- 6.2.17.16 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct Y_{NB} azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- a. VERB 24, ENTER
 - b. +xxx.xx ± 002.00 degrees, ENTER (Y_{NB} azimuth)
 - c. ±xx.xxx ± 02.000 degrees, ENTER (Y_{NB} elevation)
 - d. VERB 33, ENTER
- 6.2.17.17 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- a. R1 = +xxx.xx (Z_{NB} Azimuth)
 - b. R2 = ±xx.xxx (Z_{NB} Elevation)
 - c. R3 = 00002
- 6.2.17.18 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct Z_{NB} azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- a. VERB 24, ENTER
 - b. +xxx.xx ± 002.00 degrees, ENTER (Z_{NB} Azimuth)
 - c. ±xx.xxx ± 02.000 degrees, ENTER (Z_{NB} elevation)
 - d. VERB 33, ENTER
- 6.2.17.19 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- a. R1 = +xxx.xx (Target 1 Azimuth)
 - b. R2 = ±xx.xxx (Target 1 Elevation)
 - c. R3 = 00001
- 6.2.17.20 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct azimuth and elevation for Target 1, correct the data by entering the following sequence into the DSKY.
- a. VERB 24, ENTER
 - b. +xxx.xx ± 000.10 degrees, ENTER (Target 1 Azimuth)
 - c. ±xx.xxx ± 00.010 degrees, ENTER (Target 1 Elevation)
 - d. VERB 33, ENTER
- 6.2.17.21 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- a. R1 = +xxx.xx (Target 2 Azimuth)
 - b. R2 = ±xx.xxx (target 2 Elevation)
 - c. R3 = 00002

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- 6.2.17.22 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct azimuth and elevation for Target 2, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx,xxx±000.10 degrees, ENTER (Target 2 Azimuth)
 - ±xx,xxx±00.010 degrees, ENTER (Target 2 Elevation)
 - VERB 33, ENTER
- 6.2.17.23 Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds and return the OPTICS MODE switch to MAN. When VERB 51 NOUN 30 flashes on the DSKY set the OPTICS MODE switch on the G&N Indicator Control Panel to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.
- 6.2.17.24 Using the Optics Hand Controller, align the SXT StLos with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.25 When VERB 51 NOUN 30 flashes on the DSKY set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.
- 6.2.17.26 Using the Optics Hand Controller, align the SXT StLos with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.
- NOTE: The following two MARKS must be performed as quickly as possible. In no case shall the time between the first and second MARK exceed two minutes.
- 6.2.17.27 Repeat steps 6.2.17.23 through 6.2.17.26.
- 6.2.17.28 In approximately 7 minutes VERB 06 NOUN 66 shall flash on the DSKY and the test results shall be displayed. R1 and R2 on the DSKY shall display the misalignment of one of the horizontal PIPA's in arc seconds (R1=whole, R2=fractional). Record R1 and R2. (See Table II for PIPA displayed).
- 6.2.17.29 Enter VERB 33 ENTER into the DSKY. When VERB 06 NOUN 66 flashes R1 and R2 on the DSKY shall display the misalignment of the second horizontal PIPA in arc seconds (R1 whole, R2 fractional). (See Table II for PIPA displayed.) Record R1 and R2.
- 6.2.17.30 Enter VERB 34 ENTER into the DSKY to terminate the test.
- 6.2.17.31 Repeat steps 6.2.17.11 through 6.2.17.30 substituting position No.00002 in 6.2.17.14a
- 6.2.17.32 Enter the following into the DSKY.
- VERB 36, ENTER
 - VERB 41 NOUN 20, ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER

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Table II. Display Conditions at Test Completion

Position	SM Orientation			Horizontal Misalignment Component	
	X _{SM}	Y _{SM}	Z _{SM}	6.2.17.28	6.2.17.29
1	UP	SW	SE	Y _{SM}	Z _{SM}
2	SE	SW	DN	X _{SM}	Y _{SM}
3*	SE	UP	SW	X _{SM}	Z _{SM}

* Position 3 is not run in the Spacecraft because of GIMBAL LOCK considerations.

6.2.17.33 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.17.34 Calculations

- 6.2.17.34.1 a. Y_{SM} misalignment = () $\frac{R1 \cdot R2}{R1 \cdot R2}$
 b. Z_{SM} misalignment = () $\frac{R1 \cdot R2}{R1 \cdot R2}$
 c. X_{SM} misalignment = () $\frac{R1 \cdot R2}{R1 \cdot R2}$
 d. Y_{SM} misalignment = () $\frac{R1 \cdot R2}{R1 \cdot R2}$

6.2.17.34.2 Enter the latest values from 6.2.16 IMU Performance Test.

- a. X PIPA bias = _____ cm/sec²
 b. Y PIPA bias = _____ cm/sec²
 c. Z PIPA bias = _____ cm/sec²
 d. $\theta_x = 210$ (X PIPA bias) = _____ arc sec.
 e. $\theta_y = 210$ (Y PIPA bias) = _____ arc sec.
 f. $\theta_z = 210$ (Z PIPA bias) = _____ arc sec.

- 6.2.17.34.3 a. Y_{SM} misalignment (Bias corrected) = 6.2.16.34.1a - θ_y = _____ arc sec.
 b. Z_{SM} misalignment (Bias corrected) = 6.2.16.34.1b - θ_z = _____ arc sec.
 c. X_{SM} misalignment (Bias corrected) = 6.2.16.34.1c - θ_x = _____ arc sec.
 d. Y_{SM} misalignment (Bias corrected) = 6.2.16.34.1d - θ_y = _____ arc sec.

The SM misalignments in each orientation, excluding PIPA bias, shall not exceed ± 150 arc seconds.

6.2.18 Gyrocompassing Test

NOTE: Perform Master Initialization 6.2.5.3 before proceeding.

6.2.18.1 Set the G/N POWER-OPTICS Switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0 \pm 3.0 VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90°h (CG 1212) are not flashing on the CRT.

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6.2.18.2 Enter the following into the DSKY.

- a. VERB 01 NOUN 01, ENTER
- b. 00362, ENTER
- Record R1 = XXXXY

6.2.18.3 Enter the following into the DSKY.

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table II and XXXX is that recorded in 6.2.18.2.

Table II

Y (From 6.2.18.2)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.18.4 Enter the following sequence into the K-Start, pressing ENTER pushbutton after each entry.

- a. VERB 57, ENTER
- b. 00006, ENTER

6.2.18.5 System shall advance to Gyrocompass System Test and display 01 on the CRT program display.

6.2.18.6 On the CRT observe VERB 06, NOUN 61 flashing with some launch azimuth displayed in R1 = +xxx.xx.

6.2.18.6.1 If the azimuth displayed is correct proceed to 6.2.18.5; if not, perform the following sequence:

- a. VERB 21, Press ENTER pushbutton
- b. +xxx.xx, press ENTER pushbutton (Correct Launch Azimuth)

6.2.18.7 After verifying that the correct launch azimuth is displayed in R1 on the CRT, Enter VERB 33 on the K-START and push the ENTER pushbutton.

6.2.18.8 Observe VERB 06 NOUN 61 flashing on the CRT with the following displayed in R1 and R2.

- a. R1 = ±xxx.xx, Nav. Base Azimuth (Z_{NB})
- b. R2 = ±xx.xxx, Site Latitude

6.2.18.8.1 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence:

To correct R1:

- a. VERB 21, ENTER
- b. +xxx.xx±000.50 degrees, ENTER (Z_{NB} Azimuth)

To correct R2:

- a. Verb 22, ENTER
- b. ±xx.xxx, ENTER (Correct Site Latitude from Table I)

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- 6.2.18.9 After the correct data for R1 and R2 are verified enter VERB 33 into the K-Start. Press the ENTER pushbutton. On the CRT observe the PROGRAM display change to 05 after approximately 90 seconds. After approximately 15 minutes, observe the PROGRAM display change to 02.
- 6.2.18.10 After 120 minutes set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.11 Enter VERB 52 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT change to 03.
- 6.2.18.12 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 1 azimuth and elevation.
- R1 = +xxx.xx (Target 1 azimuth)
 - R2 = +00.000 (Target 1 elevation)
- 6.2.18.13 Verify the data appearing in R1 and R2 and if correct, proceed. If not correct, perform the following sequence.
- VERB 24, ENTER
 - +xxx.xx + 000.01, ENTER (Target 1 azimuth)
 - +00.000, ENTER (Target 1 elevation)
- 6.2.18.14 After the correct readings for R1 and R2 are verified, enter VERB 33 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.15 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 2 azimuth and elevation.
- R1 = +xxx.xx (Target 2 azimuth)
 - R2 = +00.000 (Target 2 elevation)
- 6.2.18.16 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence.
- VERB 24, ENTER
 - +xxx.xx + 000.01, ENTER (Target 2 azimuth)
 - +00.000, ENTER (Target 2 elevation)
- 6.2.18.17 After the correct readings for R1 and R2 are verified enter VERB 33 into the K-Start. Press the ENTER pushbutton.

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- 6.2.18.18 On the G&N Indicator Central Panel set the OPTICS MODE switch to MAN and the CONTROLLER SPEED to HI. Using the Optics Hand Controller, drive the SEXTANT to the approximate position of Target 1.
- 6.2.18.19 Set the CONTROLLER SPEED switch on the G&N Indicator Central Panel to LO. Using the Optics Hand Controller, align the SEXTANT to Target 1 and press the MARK pushbutton. If satisfied that the MARK was good, proceed. If not satisfied with MARK, press the MARK REJECT pushbutton and repeat the step.
- 6.2.18.20 Set the CONTROLLER SPEED switch to HI. Using the Optics Hand Controller, drive the SEXTANT to the approximate position of Target 2.
- 6.2.18.21 Set the CONTROLLER SPEED switch to LO. Using the Optics Hand Controller, align the SEXTANT to Target 2 and press the MARK pushbutton. If satisfied that the MARK was good, press the ENTER pushbutton. If not satisfied, press the MARK REJECT pushbutton and repeat this step.
- 6.2.18.22 On the CRT observe the following data displayed:
- a. VERB 06 NOUN 60
 - b. R1 = \pm xx.xxx (X gyre elevation error, degrees)
 - c. R2 = \pm xx.xxx (Y gyre elevation error, degrees)
 - d. R3 = \pm xx.xxx (Z gyre azimuth error, degrees)
- Record R1, R2 and R3.
- 6.2.18.23 Enter VERB 34 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT and DSKY's indicators Q2. Set the OPTICS MODE switch on the G&N Indicator Central Panel to ZERO.
- 6.2.18.24 Repeat steps 6.2.18.11 through 6.2.18.23 for the next hour at the following intervals.
- a. 15 minutes
 - b. 30 minutes
 - c. 45 minutes
 - d. 60 minutes

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6.2.18.25 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

6.2.18.26 Enter VERB 41 NOUN 20 into the K-Start. Press the **ENTER** pushbutton. Enter +00000 into the K-Start three times. Press the **ENTER** pushbutton after each entry. Set the G/N POWER-OPTICS Switch on the LEB Lighting Control Panel to OFF.

6:2:18:27 Data Sheet

Step No.	Parameter	Recorded Value
6.2.18.22		
1	X Gyre Elevation Error	+ $\frac{R_1}{R_2}$ degrees
2	Y Gyre Elevation Error	+ $\frac{R_2}{R_3}$ degrees
3	Z Gyre Azimuth Error	+ $\frac{R_3}{R_4}$ degrees
6.2.18.24.a		
4	X Gyre Elevation Error	+ $\frac{R_1}{R_2}$ degrees
5	Y Gyre Elevation Error	+ $\frac{R_2}{R_3}$ degrees
6	Z Gyre Azimuth Error	+ $\frac{R_3}{R_4}$ degrees
6.2.18.24.b		
7	X Gyre Elevation Error	+ $\frac{R_1}{R_2}$ degrees
8	Y Gyre Elevation Error	+ $\frac{R_2}{R_3}$ degrees
9	Z Gyre Azimuth Error	+ $\frac{R_3}{R_4}$ degrees
6.2.18.24.c		
10	X Gyre Elevation Error	+ $\frac{R_1}{R_2}$ degrees
11	Y Gyre Elevation Error	+ $\frac{R_2}{R_3}$ degrees
12	Z Gyre Azimuth Error	+ $\frac{R_3}{R_4}$ degrees
6.2.18.24.d		
13	X Gyre Elevation Error	+ $\frac{R_1}{R_2}$ degrees
14	Y Gyre Elevation Error	+ $\frac{R_2}{R_3}$ degrees
15	Z Gyre Azimuth Error	+ $\frac{R_3}{R_4}$ degrees

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6.2.18.28 Calculations Sheet

6.2.18.28.1 Record the most recent values of the following coefficients from 6.2.16, IMU Performance Test.

- a. NBDX = () _____
- b. NBDY = () _____
- c. NBDZ = () _____
- d. ADIAZ = () _____
- e. ADSRAY = () _____

6.2.18.28.2 Perform the following calculations. (Cos λ functions are provided in Table L.)

- a. $D_{(vert)} = NBDX + ADIAZ$
 $D_{(vert)} = () \text{ meru}$
- b. $D_{(east)} = \frac{\sin(\text{Launch Az})}{\cos(\text{Launch Az})} \frac{NBDX}{NBDY + ADSRAY}$
- c. $\phi_{(vert)} = \frac{D_{(vert)} \times \frac{12.8}{\cos \lambda} + D_{(east)} \times \frac{206}{\cos \lambda}}{3600}$
 $\phi_{(vert)} = () \text{ meru}''$

Table I

Location	Latitude λ	Cos λ
NAA	33.921	0.82985
MILA	28.516	0.87868
MSC	29.556	0.86993

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6.2.18.28.3

Perform the following calculations using the recorded data from 6.2.18.27 and 6.2.18.28.2.

- a. Z Gyre azimuth error 2 hrs (corrected) = line 3 - ϕ (vert)
 Z Gyre azimuth error 2 hrs (corrected) = _____
 Corrected Z Gyre azimuth error (corrected) shall be 0.00 \pm 0.57 degrees
- b. X Gyre elevation error (2 hr) = line 1
 X Gyre elevation error (2 hr) = _____ degrees
- c. Y Gyre elevation error (2 hr) = line 2
 Y Gyre elevation error (2 hr) = _____ degrees
 The X and Y Gyre elevation errors shall be 0.00 \pm 0.08 degrees.
- d. Δ Z Gyre azimuth error (3 hr) = line 3 - line 15
 Δ Z Gyre azimuth error (3 hr) = _____ degrees
 Δ Z Gyre azimuth error shall be 0.00 \pm 0.06 degrees.
- e. Δ X Gyre elevation error (3 hr) = line 1 - line 13
 Δ X Gyre elevation error (3 hr) = _____ degrees
- f. Δ Y Gyre elevation error (3 hr) = line 2 - line 14
 Δ Y Gyre elevation error (3 hr) = _____ degrees
 Δ X and Δ Y Gyre elevation error shall be 0.00 \pm 0.03 degrees.

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6.2.19 CMC Voltage Margin Test

6.2.19.1 Verify that the G&N IMU HTR MNA and MNB breakers are engaged, computer MNA and MNB breakers are engaged, IMU MNA and MNB breakers are not engaged, and the G&N Power-IMU switch on the LEB Lighting Control Panel is in the OFF position.

6.2.19.2 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to ON.

Caution: During the performance of this test the +4 VDC CMC Power Supply shall not be operated at less than +2.5 VDC or greater than 5.2 VDC (CG 1030). The +14 VDC CMC Power Supply shall not be operated at less than +8.5 VDC or greater than +17.0 VDC (CG 1020). The DSKY alpha numerics and status lamps shall be turned to the absolute minimum brightness for this test.

Note: The flashing indication of the CMC Power Supplies on CRT may be disregarded for this test. The charts in Table I may be used to determine approximate values for the "XX.X" values of C-156 voltage dial settings corresponding to various power supply voltages.

6.2.19.3 Units R-154, insert 0001. Verify and execute.

6.2.19.4 Insert in C-156, -040001244 and execute. Verify on CRT that GV0116 is between -3.0 and -5.0 vdc.

6.2.19.5 Insert in C-156 -050001234 and execute. Verify on CRT that GV0106 is between -4.0 and -6.0 vdc.

6.2.19.6 Units R-154, insert 0111. Verify and execute.

6.2.19.7 Observe CG 1020, +14 VDC Power Supply, and CG 1030, +4 VDC Power Supply on CRT. Repeat 6.2.19.3 through 6.2.19.6 adjusting each C Start entry until CG 1020 is 12.1, +0.1, -0.0 vdc and CG 1030 is 3.40, +0.03, -0.00 vdc.

6.2.19.8 Initiate CMC Self Check by inserting the following in K-148.

- a. ERROR RESET
- b. VERB 21, NOUN 27, ENTER
- c. 77777, ENTER

Wait 200 seconds.

6.2.19.9 Insure that the DSKY RESTART lamp does not light, and that

- a. VERB 05 NOUN 31
- b. R1 = 01102

does not appear on DSKY.

6.2.19.10 Set INHIBIT VOLTAGE FAIL switch to OFF on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. If RESTART lamp does not light, repeat 6.2.19.3.

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- 6.2.19.11 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- ERROR RESET
 - VERB 21, NOUN 27, ENTER
 - 77777, ENTER
- 6.2.19.12 Units R-154, insert 0001. Verify and execute.
- 6.2.19.13 Insert in C-156 +108001244 and execute. Verify on CRT that GV0116 is between +0.8 and +11.8 vdc.
- 6.2.19.14 Units R-154, insert 0111. Verify and execute.
- 6.2.19.15 Observe CG 1020, +14 VDC Power Supply on CRT. Repeat 6.2.19.12 through 6.2.19.14 adjusting the C Start entry until CG 1020 is 16.4, +0.0, -0.1 vdc.
- 6.2.19.16 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- VERB 05, NOUN 31
 - R1 = 01102
- does not appear on DSKY.
- 6.2.19.17 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. If RESTART lamp does not light, repeat 6.2.19.11 through 6.2.19.17 measuring CG 1020 and CG 1030 at PSAAM interface instead of CRT.
- 6.2.19.18 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- ERROR RESET
 - VERB 21, NOUN 27, ENTER
 - 77777, ENTER
- 6.2.19.19 Units R-154, insert 0001. Verify and execute.
- 6.2.19.20 Insert in C-156, +092001234 and execute. Verify on CRT that GV0106 is between +8.2 and +10.2 vdc.
- 6.2.19.21 Units R-154, insert 0111. Verify and execute.
- 6.2.19.22 Observe CG 1030, +4 VDC Power Supply on CRT. Repeat 6.2.19.19 through 6.2.19.21 adjusting the C Start entry until CG 1030 is 4.60, +0.00, -0.03 vdc.
- 6.2.19.23 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- VERB 06, NOUN 31
 - R1=01102
- does not appear on DSKY.

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- 6.2.19.24 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. If RESTART lamp does not light, repeat 6.2.19.18 through 6.2.19.24 measuring CG 1020 and CG 1030 at PSAAM interface instead of CRT.
- 6.2.19.25 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- a. ERROR RESET
 - b. VERB 21, NOUN 27, ENTER
 - c. 77777, ENTER.
- 6.2.19.26 Units R-154, insert 0001. Verify and execute.
- 6.2.19.27 Insert in C-156, -040001244 and execute. Verify on CRT that GV0116 is between -3.0 and -5.0 vdc.
- 6.2.19.28 Units R-154, insert 0111. Verify and execute.
- 6.2.19.29 Observe CG 1020, +14 VDC Power Supply on CRT. Repeat 6.2.19.26 through 6.2.19.28 adjusting the C Start entry until CG 1020 is 12.1, +0.1, -0.0 vdc.
- 6.2.19.30 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- a. VERB 05, NOUN 31
 - b. R1 = 01102
- does not appear on DSKY.
- 6.2.19.31 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. If RESTART lamp does not light, repeat 6.2.19.25 through 6.2.19.31 measuring CG 1020 and CG 1030 at PSAAM interface instead of CRT.
- 6.2.19.32 Units R-154, insert 0000. Verify and execute.
- 6.2.19.33 Terminate CMC Self-Check by inserting into K-148:
- a. ERROR RESET
 - b. VERB 21, NOUN 27, ENTER
 - c. 00000, ENTER
- 6.2.19.34 Ensure that CG 1020, +14 VDC Power Supply indication is +14.0, ±0.4, and that CG 1030, +4 VDC Power Supply indication is +4.00±0.30 VDC on CRT.

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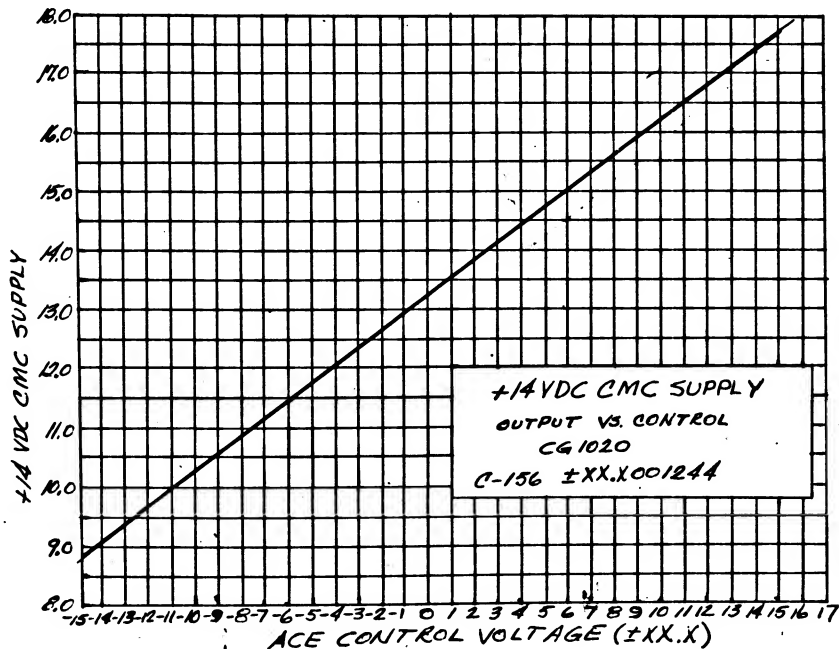
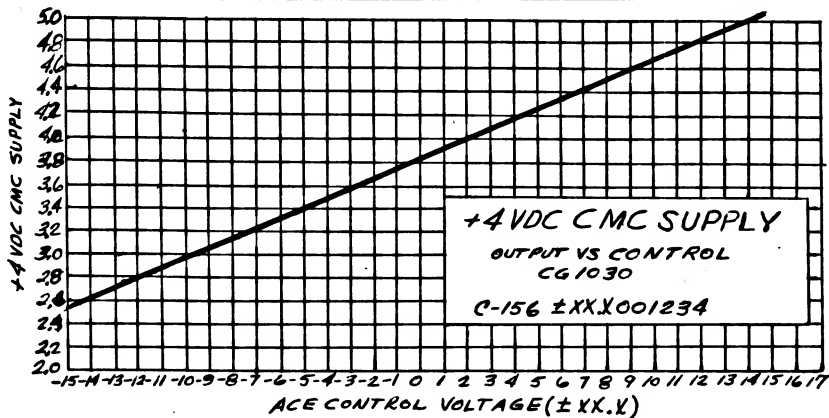


TABLE I

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6.2.21 Spacecraft Control and Displays Test

6.2.21.1 Perform Master Initialization before proceeding. f a system operation
proceeding.

6.2.21.2 FDAI Attitude Error

6.2.21.2.1 Insert in K148

- a. V 57 ENTER
- b. 00013 ENTER

6.2.21.2.2 Observe on CRT

- a. V 06 NO1 Flashing
- b. PROG 07
- c. NO ATT ON
- d. R1, R2, and R3 Approx. 00000

6.2.21.2.3 Insert in K148

- a. VERB 33, ENTER

6.2.21.2.4 Observe on CRT

- a. V 06 NO1 Flashing
- b. R1 +00385
- c. R2 -00385
- d. R3 +00385
- e. NO ATT OFF

6.2.21.2.5 Record CRT indications

- a. CG 2279 ROLL ATT ERROR - CDU DAC OUT $+16.88 \pm 1.65$ degrees
- b. CG 2219 PITCH ATT ERROR - CDU DAC OUT -16.88 ± 1.65 degrees
- c. CG 2249 YAW ATT ERROR - CDU DAC OUT $+16.88 \pm 1.65$ degrees

6.2.21.2.6 Insert in K148

- a. VERB 33, ENTER

6.2.21.2.7 Observe on CRT

- a. V 06 NO1 Flashing
- b. R1 +00384
- c. R2 -00384
- d. R3 +00384

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6.2.21.2.8 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	+16.88 ±1.65 degrees
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	+16.88 ±1.65 degrees

6.2.21.2.9 Insert in K148

a. VERB 33, ENTER

6.2.21.2.10 Observe on CRT

a.	V 06	N01	Flashing
b.	R1		+00160
c.	R2		-00160
d.	R3		+00160

6.2.21.2.11 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	+6.95 ±0.69 degrees
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	-6.95 ±0.69 degrees
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	+6.95 ±0.69 degrees

6.2.21.2.12 Insert in K148

a. VERB 33, ENTER

6.2.21.2.13 Observe on CRT

a.	V 06	N01	Flashing
b.	R1		+00135
c.	R2		-00135
d.	R3		+00135

6.2.21.2.14 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	+5.88 ±0.59 degrees
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	-5.88 ±0.59 degrees
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	+5.88 ±0.59 degrees

6.2.21.2.15 Insert in K148

a. VERB 33, ENTER

6.2.21.2.16 Observe on CRT

a.	V 06	N01	Flashing
b.	R1		+00090
c.	R2		-00090
d.	R3		+00090

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6.2.21.2.17 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	+3.93 ±0.39 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	-3.93 ±0.39 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	+3.93 ±0.39 degrees

6.2.21.2.18 Insert in K148

a. VERB 33, ENTER

6.2.21.2.19 Observe on CRT

a. V 06	N01	Flashing
b. R1		+00000
c. R2		+00000
d. R3		-00090

6.2.21.2.20 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	0.00 ±0.19 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	0.00 ±0.19 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-3.93 ±0.39 degrees

6.2.21.2.21 Insert in K148

a. VERB 33, ENTER

6.2.21.2.22 Observe on CRT

a. V 06	N01	Flashing
b. R1		-00090
c. R2		+00090
d. R3		-00135

6.2.21.2.23 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-3.93 ±0.39 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+3.93 ±0.39 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-5.88 ±0.59 degrees

6.2.21.2.24 Insert in K148

a. VERB 33, ENTER

6.2.21.2.25 Observe on CRT

a. V 06	N01	Flashing
b. R1		-00135
c. R2		+00135
d. R3		-00160

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6.2.21.2.26 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	-5.88 ±0.59 degrees
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	+5.88 ±0.59 degrees
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	-6.95 ±0.69 degrees

6.2.21.2.27 Insert in K148

a. VERB 33, ENTER

6.2.21.2.28 Observe on CRT

a.	V 06	NO1	Flashing
b.	R1		-00160
c.	R2		+00160
d.	R3		-00384

6.2.21.2.29 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	-6.95 ±0.69 degrees
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	+6.95 ±0.69 degrees
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees

6.2.21.2.30 Insert in K148

a. VERB 33, ENTER

6.2.21.2.31 Observe on CRT

a.	V 06	NO1	Flashing
b.	R1		-00384
c.	R2		+00384
d.	R3		-00385

6.2.21.2.32 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	+16.88 ±1.65 degrees
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees

6.2.21.2.33 Insert in K148

a. VERB 33, ENTER

6.2.21.2.34 Observe on CRT

a.	V 06	NO1	Flashing
b.	R1		-00385
c.	R2		+00385
d.	R3		+00000

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6.2.21.2.35 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+16.88 ±1.65 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	0.00 ±0.19 degrees

6.2.21.2.36 Insert in K148

a. V 21	NO1	ENTER
b. 02545		ENTER
c. 03302		ENTER
d. V 33		ENTER

6.2.21.2.37 Observe on CRT

a. V 96	NO3	Flashing
b. NO ATT		ON
c. R1		+00000 approximately
d. R2		+00000 approximately
e. R3		+00000 approximately

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6.2.21.3 TVC Test

6.2.21.3.1 The G/N Autopilot Control and SPS Ready discretes shall be applied to the G/N interface.

6.2.21.3.2 Set the OPTICS MODE selector on the Indicator Control panel to MAN.

6.2.21.3.3 Insert in K148

a. VERB 33, ENTER

6.2.21.3.4 Observe on CRT

a. V 01	N 10	Flashing
b. R1		X7373
c. R3		00030

6.2.21.3.5 Insert in K148

a. V 33 ENTER

6.2.21.3.6 Observe on CRT

a. V 01	NOUN 10	Flashing
b. R1		37777
c. R3		00031

6.2.21.3.7 Insert in K148

a. V 33 ENTER

6.2.21.3.8 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00385
c. R2		-00385
d. R3		+00003

6.2.2.3.9 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+16.88 ±1.00 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-16.88 ±1.00 degrees

6.2.21.3.10 Insert in K148

a. VERB 33, ENTER

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6.2.21.3.11 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00384
c. R2		-00384
d. R3		+00003
e. NO ATT		OFF

6.2.21.3.12 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+16.88 ±1.00 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-16.88 ±1.00 degrees

6.2.21.3.13 Insert in K148

a. VERB 33, ENTER

6.2.21.3.14 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00160
c. R2		-00160
d. R3		+00003

6.2.21.3.15 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+6.95 ±0.41 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-6.95 ±0.41 degrees

6.2.21.3.16 Insert in K148

a. VERB 33, ENTER

6.2.21.3.17 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00135
c. R2		-00135
d. R3		+00003

6.2.21.3.18 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+5.88 ±0.35 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-5.88 ±0.35 degrees

6.2.21.3.19 Insert in K148

a. VERB 33, ENTER

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6.2.21.3.20 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00090
c. R2		-00090
d. R3		+00003

6.2.21.3.21 Record CRT indications.

a. CG 3722	TRUNNION CDU DAC OUTPUT	+3.93 ±0.24 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-3.93 ±0.24 degrees

6.2.21.3.22 Set the OPTICS CONTROLLER SPEED Switch on the Indicator Control panel to HI.

6.2.21.3.23 Insert in K148

a. VERB 33, ENTER

6.2.21.3.24 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00000
c. R2		+00000
d. R3		+00003

6.2.21.3.25 While holding the Optics Hand Controller up and left (45°) no longer than 10 seconds, record CRT indications.

a. CG 3722	TRUNNION CDU DAC OUTPUT	0.00 ±0.19 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	0.00 ±0.19 degrees

6.2.21.3.26 Insert in K148

a. VERB 33, ENTER

6.2.21.3.27 Observe on CRT

a. V 06	N 03	Flashing
b. R1		-00090
c. R2		+00090
d. R3		+00003

6.2.21.3.28 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-3.93 ± .24 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	+3.93 ± .24 degrees

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6.2.21.3.29 Set the OPTICS MODE Switch on the Indicator Control panel to ZERO for 30 seconds, then return to MAN.

6.2.21.3.30 Insert in K148

a. VERB 33, ENTER

6.2.21.3.31 Observe on CRT

a. V 06	N 03	Flashing
b. R1		-00135
c. R2		+00135
d. R3		+00003

6.2.21.3.32 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-5.88 ±0.35 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	+5.88 ±0.35 degrees

6.2.21.3.33 Insert in K148

a. VERB 33, ENTER

6.2.21.3.34 Observe on CRT

a. V 06	N 03	Flashing
b. R1		-00160
c. R2		+00160
d. R3		+00003

6.2.21.3.35 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-6.95 ±0.41 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	+6.95 ±0.41 degrees

6.2.21.3.36 Insert in K148

a. VERB 33, ENTER

6.2.21.3.37 Observe on CRT

a. V 06	N 03	Flashing
b. R1		-00384
c. R2		+00384
d. R3		+00003

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6.2.21.3.38 Record CRT indications

a. CG 3722 TRUNNION CDU DAC OUTPUT -16.88 ±1.00 degrees
b. CG 3721 SHAFT CDU DAC OUTPUT +16.88 ±1.00 degrees

6.2.21.3.39 Insert in K148

a. VERB 33, ENTER

6.2.21.3.40 Observe on CRT

a. V 06 N 03 Flashing
b. R1 -00385
c. R2 +00385
d. R3 +00003

6.2.21.3.41 Record CRT indications

a. CG 3722 TRUNNION CDU DAC OUTPUT -16.88 ±1.00 degrees
b. CG 3721 SHAFT CDU DAC OUTPUT +16.88 ±1.00 degrees

6.2.21.3.42 Insert in K148

a. V 34 ENTER
b. V 40 N 20 ENTER
c. V 41 N 20 ENTER
d. +00000 ENTER
e. +00000 ENTER
f. +00000 ENTER

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APPENDIX I

<u>Signal</u>	<u>Nomenclature</u>	<u>G&N Test Requirement</u>	<u>PSAAM and/or SCA Uncertainty % of Full Scale</u>
CG 1020	+14 VDC CMC SUPPLY	+14.0 ± 0.4 VDC	0%
CG 1030	+4 VDC CMC SUPPLY	+4.00 ± 0.2 VDC	0%
CG 1040	+120 VDC PIPA SUPPLY	+120 ± 6.0 VDC	1%
CG 1051	+20 VDC PIPA SUPPLY	+20.0 ± 1.2 VDC	0%
CG 1052	-20 VDC PIPA SUPPLY	-20 ± 2 VDC	0%
CG 1070	+4 VDC CDU SUPPLY	+4.0 ± 0.2 VDC	0%
CG 1100	-28 VDC SUPPLY	-27.5 ± 6.0 VDC	0%
CG 1110	2.5 VDC TM BIAS	+2.50±0.05 VDC	0%
CG 1201	IMU 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	1%
CG 1202	IMU 28V .8 KC 5% - 90° RMS	28.0 ± 1.4 VRMS	1.5%
CG 1203	IMU 28V .8KC 0° RMS	28.0 ± 2.1 VRMS	1.5%
CG 1207	PH DIFF IMU 5% 0°, -90°	90 ± 10°	3%
CG 1211	OPTX 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	1.5%
CG 1212	OPTX 28V .8KC 5% -90° RMS	28.00 ± 1.48 VRMS	1.5%
CG 1220	PH DIFF OPTX 1% IMU 1%	0° ± 10°	3%
CG 1331	3.2 KC 28V SUPPLY	28.6 ± 0.56 VRMS	1%
CG 1336	PH DIFF 3.2 KC 28V/CMC SYNC	0° ± 10°	3%
CG 1500	+28 VDC IMU OPERATE BUS	28.8 ± 3VDC	0%
CG 1510	+28 VDC IMU STANDBY BUS	28.8 ± 3 VDC	0%
CG 1520	+28 VDC CMC OPERATE BUS	28.8 ± 3 VDC	0%
CG 1530	+28 VDC OPTX OPERATE BUS	28.8 ± 3 VDC	0%
CG 2001	X PIPA SG O/P	5 VRMS max	3%
CG 2021	Y PIPA SG O/P	5 VRMS max	3%
CG 2041	Z PIPA SG O/P	5 VRMS max	3%
CG 2108	IG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2112	IG 1X RESOLVER O/P SIN	(18.38 ± 1.84)	2.5%
CG 2113	IG 1X RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	
CG 2117	IG SERVO ERROR IN PHASE	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2120	IG TORQUE MOTOR CURRENT	0.0 ± 60mv RMS @ null	2%
		0.125 amp max during Fine Alignment Torquing	2%
CG 2138	MG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2142	MG 1X RESOLVER O/P SIN	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2143	MG 1X RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2147	MG SERVO ERROR IN PHASE	0.0 ± 60 mv rms @ null	2%
CG 2150	MG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	2%
CG 2168	OG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2172	OG 1X RESOLVER O/P SIN	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2173	OG 1X RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2177	OG SERVO ERROR IN PHASE	0.0 ± 60mvRMS @ null	2%
CG 2180	OG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	2%

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<u>Signal</u>	<u>Nomenclature</u>	<u>G&N Test Requirement</u>	<u>PSAAM and/or SCA Uncertainty % of Full Scale</u>
CG 2219	PITCH ATT ERROR - CDU DAC O/P	5.06 ± 0.5 VRMS @ 17°	2%
CG 2220	IG CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 2221	IG CDU COARSE ERROR	0.0 ± 0.68 VRMS @null	1%
CG 2249	YAW ATT ERROR-CDU DAC O/P	5.06 ± 0.5VRMS @ 17°	2%
CG 2250	MG CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 2251	MG CDU COARSE ERROR	0.0 ± 0.68VRMS @ null	1%
CG 2279	ROLL ATT ERROR-CDU DAC O/P	5.06 ± 0.5VRMS @17°	2%
CG 2280	OG CDU FINE ERROR	0.0 ± 0.07 VRMS 2 null	1%
CG 2281	OG CDU COARSE ERROR	0.0 ± 0.68 VRMS	1%
CG 2300	PIPA TEMPERATURE	130 ± 1.5°F Operate Mode	0%
CG 3011	TRUNNION CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 3021	SHAFT CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 3117	SXT SHAFT SERVO ERROR IN PH	2 VRMS max	2%
CG 3118	SXT TRUNNION SERVO ERROR IN PHASE	2 VRMS max	2%
CG 3140	SXT SHAFT TACH C/P	3.1 ± 1.1VRMS @ Hi Rate	2%
CG 3145	SXT SHAFT MTR CONTROL WINDING	3.3 ± 1.3VRMS @ Hi Rate	2%
CG 3150	SXT TRUNNION TACH O/P	3.3 ± 1.3VRMS @ Hi Rate	2%
CG 3155	SXT TRUNNION MTR CONTROL WINDING	0.85 ± 0.35VRMS at Hi Rate	2%
CG 3160	SCT SHAFT TACH O/P	3.3 ± 1.3 VRMS @ Hi Rate	2%
CG 3170	SCT TRUNNION TACH O/P	0.85 ± 0.35VRMS @Hi Rate	2%
CG 3721	SHAFT CDU DAC O/P	5.06 ± 0.50VRMS @17°	1%
CG 3722	TRUNNION CDU DAC O/P	5.06 ± 0.50VRMS @ 17°	1%
CG 4300	CMC TEMP	87.5±42.5°F	0%
CG 6020	PIPA CAL MODULE TEMP	72.5±27.5°F	0%
CG 6021	IMU 800 cps 5% TEMP (PSA)	80±30°F	0%
CG 2301	IRIG TEMPERATURE	135 ± 2.5°F in Operate	0%

All uncertainties specified above and those due to instrumentation in the ACE equipment shall be root sum squared with the basic system tolerances to yield an acceptable tolerance for use when testing the G&N System in the spacecraft.

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ADDENDUM I

SCOPE: The following changes are required to make ND1002325 applicable as G&N System technical support documentation for CSM 101.

Addition 1: Page 52 paragraph 6.2.7.2.7. Add the following:
During this 12 minute period monitor IG TORQUE MOTOR CURRENT (CG 2120) on the CRT. This measurement shall not exceed 0.125 amp.

Addition 2: Page 53 paragraph 6.2.7.3.5. Add the following:
During this 12 minute period monitor OG TORQUE MOTOR CURRENT (CG 2180) on the CRT. This measurement shall not exceed 0.125 amp.

Addition 3: Page 55, paragraph 6.2.7.4.5. Add the following:
During this 5 minute period monitor MG TORQUE MOTOR CURRENT (CG 2150) on the CRT. This measurement shall not exceed 0.125 amp.

Addition 4: Page 42. Add 6.2.4.14 on the Event Recorder verify that the IMU HTR CURRENT (CG 2302) discrete and IMU BLOWER CURRENT (CG 2303) discrete are cycling on and off.

Addition 5: Page 74 paragraph 6.2.13.6. Add the following step prior to 6.2.13.6:
During the Trunnion Slew Rate Test HI Speed (6.2.13.6) monitor and verify the following signals on the CRT.

Signal	Requirement
a. SXT TRUNNION TACH O/P (CG 3150)	3.3±1.3 VRMS
b. SCT TRUNNION TACH O/P (CG 3170)	-0.85±0.35 VRMS

Addition 6: Page 73 paragraph 6.2.13.9. Add the following step prior to 6.2.13.9:
During the Shaft Slew Rate Test - HI speed (6.2.13.9) monitor and verify the following signals on the CRT.

Signal	Requirement
a. SXT SHAFT TACH O/P (CG 3140)	3.3±1.3 VRMS
b. SCT SHAFT TACH O/P (CG 3160)	-3.3±1.3 VRMS

Addition 7: Page 77 paragraph 6.2.13.18. Add the following step prior to 6.2.13.18:
During the Trunnion Slew Rate Test LO Speed monitor and verify the following signal on the CRT.

Signal	Requirement
a. TRUNNION CDU FINE ERROR (CG 3011)	±.07 VRMS MAX.

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Addition 8: Page 77 paragraph 6.2.13.21. Add the following step prior to 6.2.13.21:
During the Shaft Slew Rate Test LO Speed Monitor and verify the following
signal on the CRT.

Signal

Requirement

a. SHAFT CDU FINE ERROR (CG 3021)

a. 07 VRMS MAX

Addition 9: Page 17 paragraph 6.1.2.1. Add new paragraph 6.1.2.1.5 as follows:
Data from the on board tape recorder shall be made available and the
following signals verified.

a. VIB NB ROLL (CG 6001)

b. VIB NB PITCH (CG 6002)

c. VIB NB YAW (CG 6003)

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ADDENDUM II

Scope: The following changes are required to make ND1002325 applicable as G&N System technical support documentation for systems containing SUNDIAL C test ropes.

Change 1: Pages 58 through 63, paragraphs 6.2.9.1.4, 6.2.9.2a, 6.2.9.3a, 6.2.9.5a, 6.2.9.6a, 6.2.9.7a, 6.2.9.8, 6.2.9.10a, 6.2.9.11a, 6.2.9.13a, 6.2.9.15a, 6.2.9.16a, 6.2.9.22. In each of these paragraphs change "VERB 06 NOUN XX flashing" to "VERB 33 NOUN XX flashing."

Change 2: Pages 111 through 120, paragraphs 6.2.21.2.2a, 6.2.21.2.4a, 6.2.21.2.7a, 6.2.21.2.10a, 6.2.21.2.13a, 6.2.21.2.16a, 6.2.21.2.19a, 6.2.21.2.22a, 6.2.21.2.25a, 6.2.21.2.28a, 6.2.21.2.31a, 6.2.21.2.34a, 6.2.21.2.37a, 6.2.21.3.8a, 6.2.21.3.11a, 6.2.21.3.14a, 6.2.21.3.17a, 6.2.21.3.20a, 6.2.21.3.24a, 6.2.21.3.27a, 6.2.21.3.31a, 6.2.21.3.34a, 6.2.21.3.37a, 6.2.21.3.40a. In each of these steps change "V06" to "V33".

END OF ADDENDUM II

APOLLO G&N Specification
ND 1002325 REV E

Original Issue Date:
Release Authority: TDRR 31414
Class A Release

POST INSTALLATION CHECKOUT PROCESS
SPECIFICATION FOR THE APOLLO GUIDANCE
AND NAVIGATION SYSTEM -- BLOCK II

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
11/1/66	A	31765	1-116 was 116 pages, now 118 pages.	EA	WLS
1/26/67	B	32784	2, 3, 6, 9, 11, 15, 16, 24, 27, 29, 34, 38, 44-50, 54, 56-59, 61-65, 67, 68, 72-74, 76-79, 81-103, 106-117; was 118 pages, now 119 pages.	EA	-
2/7/67	C	32919	10-119, Was 119 pages now 124		
4/6/67	D	33539	8, 9, 10, 12, 15, 24, 35, 38, 40, 41, 43-46, 50-56, 58-78, 81, 83-87, 89, 95-124.	EA	-
6/22/67	E	34000	2, 6, 10, 11, 24-27, 29-124, Was 124 pages, now 131 pages.	EA	WS

This specification consists of page 1 to 131 including Appendix I pages 126, 127 and Addendum I, pages 128 and 129 and Addendum II, pages 130 and 131.

APPROVALS

NOT REQUIRED
PER
CCA-497-0274
NASA/MSC

ACFD

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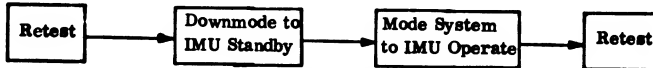
- 5.1.2.5 Failure of the G&N System to pass any examination or test specified herein shall tentatively classify the G&N System as nonconforming. The normal test sequence may be continued on determination of the cause of the nonconformance if not detrimental to the G&N System on other interfacing subsystems. This determination shall have the concurrence of the G&N contractor test team. All nonconformance shall be investigated and cleared by waiver (FNN), correction of test specification, or hardware replacement. The suspected malfunctioning hardware shall be removed and returned to the laboratory, where the malfunction shall be verified. Only after malfunction verification shall a flight certified replaceable unit be installed in the G&N System.
- 5.1.2.6 The G&N System shall be operating in STANDBY mode with CMC power applied for a minimum of two hours prior to torquing of inertial components. In the event STANDBY or CMC power is interrupted, an equivalent time period shall be allowed when power is restored before transfer to the OPERATE mode, except that when the interval of interruption exceeds two hours, a two-hour warmup period shall be mandatory. Exceptions to the above are noted in 6.2.5.2.
- 5.1.2.7 The interruption of +28 VDC power to the G&N System through the Main A and Main B power busses shall be cause for the Command Module G&N System operator to immediately initiate the Emergency shutdown procedure (6.1.4) to preclude damage to the G&N System.
- 5.1.2.8 The SCT and SXT eyepieces shall be stowed whenever the instruments are not in use to preclude damage to them. It shall be necessary to install the eyepieces when testing requires use of the instrument.
- 5.1.2.9 To preserve the operational life of the components of the MDC and LEB DSKY's, the monitor routines shall be used only when required by test procedure or troubleshooting. Such routines shall be terminated as quickly as possible in the test flow. Computer routines which cause the DSKY display to flash (either requesting data or displaying data) shall also be terminated as quickly as possible.
- 5.1.2.10 To reduce the possibility of the optics drifting into the stops the Optics Speed switch should be set to LO whenever the optics is to be ON and not used for any appreciable time.

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5.4.2 Failure of the D criteria for IRIG and PIPA parameters.

5.4.2.1 If D₁, D₂, or D₃ exceeds its maximum value as specified in Table D Paragraph 6.2.16.10.8 for any IRIG or PIPA, a retest sequence shall be initiated as indicated below:



RETEST SEQUENCE

The retest sequence shall be performed only for the test positions indicated in the table below, corresponding to the original out-of-spec parameter. In addition, selected other parameters shall be recalculated and qualified per Table D.

O.O.S PARAMETER	PERFORM POSITIONS	PARAMETERS TO BE REQUALIFIED
NBDY	1	NBDY
NBDZ	1 thru 2	NBDZ, NBDY, X PIPA S. F. error, X PIPA bias
NBDX	1 thru 3	NBDX, NBDZ, NBDY, X PIPA S. F. error, X PIPA bias, ADIAX
ADSRAY	1 thru 4	ADSRAY, NBDX, NBDZ, NBDY, X PIPA S. F. error, X PIPA bias, ADIAX, ADIAZ, Z PIPA S. F. error, Z PIPA bias
ADSRAZ	1 thru 9	ADSRAZ, ADSRAY, NBDX, NBDZ, NBDY, X PIPA S. F. error, X PIPA bias, ADIAX, ADIAZ, Z PIPA S. F. error, Z PIPA bias, ADSRAX, Y PIPA S. F. error, Y PIPA bias
ADSRAX	1 thru 7	ADSRAX, ADSRAY, NBDX, NBDZ, NBDY, X PIPA S. F. error, X PIPA bias, ADIAX, ADIAZ, Z PIPA S. F. error, Z PIPA bias, Y PIPA S. F. error, Y PIPA bias
ADIAZ	1 thru 10	All
ADIAZ	1 thru 4	ADIAZ, NBDX, NBDZ, NBDY, X PIPA S. F. error, X PIPA bias, ADIAX, Z PIPA S. F. error, Z PIPA bias, ADSRAY
ADIAZ	1 thru 3	ADIAZ, NBDX, NBDZ, NBDY, X PIPA S. F. error, X PIPA bias
X PIPA bias or S.F. error	1 thru 2	X PIPA S. F. error, X PIPA bias, NBDZ, NBDY
Z PIPA bias or S.F. error	1 thru 4	Z PIPA S. F. error, Z PIPA bias, ADSRAY, NBDX, NBDZ, NBDY, X PIPA S. F. error, X PIPA bias, ADIAX, ADIAZ
Y PIPA bias or S. F. error	1 thru 6	Y PIPA S. F. error, Y PIPA bias, Z PIPA S. F. error, Z PIPA bias, ADSRAY, NBDX, NBDZ, NBDY, X PIPA S. F. error, X PIPA bias, ADIAX, ADIAZ

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If D_1 , D_2 , or D_3 exceeds its maximum value after the retest sequence is completed, the requirements of 5.4.2.2 (IRIG) or 5.4.2.3 (PIPA) shall apply. If D_1 , D_2 , and D_3 are within tolerances specified in Table D after the retest sequence is completed, the original out-of-tolerance D terms calculated in paragraph 6.2.16.10.8 shall be exonerated.

5.4.2.2 IRIG stability requirements

5.4.2.2.1 Failure to be within the maximum values for D_1 or D_2 or D_3 after the retest sequence shall constitute failure of the unit.

5.4.2.3 PIPA stability requirements.

5.4.2.3.1 Failure to be within the maximum limits of D_1 or D_2 or D_3 after the retest sequence constitute failure of the unit.

5.5 Retest subsequent to replacement of a malfunctioned assembly with that of a flight certified assembly shall be at the discretion of NASA Engineering. Table II can be used as a guide to determine general retest requirements. In all retest procedures, the test sequence of Figure 1 shall be adhered to.

5.6 It is assumed that the Test Conductor has a working knowledge of the test equipment used; therefore, this procedure contains only the steps related directly to the G&N System components. If any questions arise concerning the test equipment, the Test Conductor should refer to the pertinent operational manuals.

5.7 The following requirements shall be completed before any of the tests in this specification are attempted.

5.7.1 The G&N System shall be Government Furnished Property.

5.7.2 The installation of the G&N System into the spacecraft shall have been completed as specified in Mechanical Installation Specification for Apollo Guidance Equipment Block II, MA0308-0107.

5.7.2.1 Interfacing systems (SCS, C & IS, EPS, ECS) shall have been verified to conform to loading and operational requirements as specified by the appropriate ICD.

5.7.3 All ACE equipment shall have been qualified in accordance with the respective quality assurance specifications prior to use with the G&N System.

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6.2 Test Procedures

6.2.1 Application of Standby Power to G&N System

- 6.2.1.1 Verify that spacecraft power checks, to include polarity and magnitude on Spacecraft Power Connector, have been made as specified in 6.1.3.
- 6.2.1.2 All power and control switches on the G&N Indicator Control Panel shall be placed in the OFF or neutral position.
- 6.2.1.3 The Inertial Component Temperature Controller (ICTC) shall be supplying inertial component heater power to the G&N System through the PSA, Connector No. 45J2.
- 6.2.1.4 Computer Power On
- 6.2.1.4.1 Set G&N COMPUTER MNA and MNB Breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in).
- NOTE: Restart Lamp may illuminate, if it does, disregard and press RSET on the DSKY.
- 6.2.1.4.2 Set the POWER-AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in), and position G/N POWER switch to AC1.
- 6.2.1.4.3 Set the computer numerical display lights to the minimum acceptable brightness by rotating the BRIGHTNESS Controls on the MDC and LEB Lighting Control Panels.
- 6.2.1.4.4 The +28 VDC CMC OPERATE voltage (CG 1520) shall be $\pm 28.8 \pm 3$ VDC. Verify CRT indication.
- 6.2.1.4.5 Using DSKY, enter VERB 36, ENTR, then press RESET. All computer alarms on the Main Display Console (MDC), LEB CMC DSKY and CRT shall clear.
- 6.2.1.4.6 The voltage output of the +4 VDC CMC supply shall be $\pm 4.00 \pm 0.20$ VDC (CG 1030). The value on the CRT shall be recorded.
- 6.2.1.4.7 The voltage output of the +14 VDC CMC supply shall be $\pm 14.0 \pm 0.4$ VDC, (CG 1020). The value on the CRT shall be recorded.
- 6.2.1.4.8 Verify that the CMC is in the Backup Mode by monitoring on the CRT that the Program indicates 00, and the Program readouts on the MDC and LEB AGC DSKY indicate 00.

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6.2.1.4.9 Zero the CMC erasable memory by entering the following sequence into the K-start:

- a. VERB 57, ENTER
- b. 00016, ENTER

6.2.1.4.10 Initiate CMC self-check by entering the following sequence into the K-start:

- a. VERB 21, NOUN 27 ENTER
- b. 77777, ENTER
- c. VERB 15 NOUN 01 ENTER
- d. 1366, ENTER

6.2.1.4.10.1 Monitor DSKY until R3 (SCOUNT +2) increments twice. If an error is detected, the following will be displayed:

- a. VERB 05 NOUN 31
- b. R1 = 01102
- c. R2 = XXXXX C (SFALL)
- d. R3 = XXXXX C (ERCOUNT)

6.2.1.4.10.2 Enter the following into the K-start:

- a. VERB 21
- b. NOUN 27, press ENTER pushbutton
- c. 00000, press ENTER pushbutton

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6.2.1.5 IMU HTR Heater Power On

6.2.1.5.1 Enter the IMU Standby Mode of operation by engaging the IMU HTR MN A and MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).

6.2.1.5.2 Verify that the IMU +28 VDC STANDBY discrete lamp on Event Module is illuminated (CG 1513).

6.2.1.5.3 Record the value of the following signals displayed on the CRT.

Signal	Requirement
a. CG 1331 28V 3200 CPS POWER SUPPLY FEEDBACK	28.6 ± 0.6 VRMS
b. CG 1510 + 28 VDC STANDBY POWER	28.8 (±3) VDC

6.2.1.5.4 The PIPA TEMP on the CRT shall be monitored at 15 min., 1 hr. and 2 hrs. from execution of 6.2.1.5.2 to insure that the PIPA Temperature Control Loop circuitry is operating to maintain a temperature of 130.5 ± 1.5F (CG 2300).

6.2.1.5.5 The IRIG TEMP on the CRT shall be monitored at 15 min., 1 hr., and 2 hrs. after 6.2.1.5.2 is executed to insure that the IRIG Temperature (CG 2301) is within 3.0 degrees of the PIPA Temperature.

6.2.1.5.6 At the termination of the 2-hour period, record the PIPA temperature (CG 2300) on the CRT. Verify the presence of IMU HEATER current (CG 2302) and IMU BLOWER current (CG 2303) discrete on the event recorder over the last two hour period (occasionally discretes may cycle OFF.)

6.2.1.5.7 With the eyepiece in the Eyepiece Storage Unit, check the eyepiece surface temperature at the quick disconnect flange using an L&N #8693 Temperature Potentiometer, or a similar type thermocouple probe meter. Record both the ambient and eyepiece surface temperatures and verify that the eyepiece surface temperature is at least 10°F above the ambient temperature.

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6.2.2 CMC Operational Test

NOTE: This test shall be performed when only IMU HTR and Computer Power is applied. The test shall not be performed when IMU OPERATE power is applied.

6.2.2.1 Verify that IMU STANDBY power (including CMC operate power) is applied, IMU OPERATE power is not applied. (G & N IMU HTR MN A and MN B breakers engaged, Computer MN A and MN B breakers engaged, IMU MN A and MN B breakers disengaged, G/N Power-IMU switch on LEB Lighting Control Panel in OFF Position).

6.2.2.1.1 Using the LEB CMC DSKY, enter VERB 36, ENTER then press RESET.

6.2.2.2 CMC Checks

6.2.2.2.1 Using the LEB CMC DSKY, enter the following sequence of data into the CMC to initiate the DSKY check. Press the ENTER pushbutton after each entry (denoted by E).

VERB 21 NOUN 27, E
 77766, E

6.2.2.2.2 DSKY check shall check all the electroluminescent elements by displaying the decimal numbers from nine through zero in succession, each set of numbers shall be displayed for approximately 5 seconds. Verify all elements operable on MDC and LEB CMC DSKY's. VERB-NOUN display shall flash.

6.2.2.2.3 Minus and plus signs shall be displayed. Verify operation on MDC and LEB DSKY's.

6.2.2.2.4 COMP ACTY lamp shall be illuminated for approximately 5 seconds, then DSKY shall blank.

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6.2.2.4.1 Enter the following sequence into the LEB CMC DSKY. Press the ENTER pushbutton after each entry (denoted by E).

- a. VERB 25 NOUN 01, E
- b. 01600, E
- c. +00123, E
- d. -00456, E
- e. -00789, E

6.2.2.4.2 The LEB CMC DSKY shall indicate +00123 in R1, -00456 in R2, and -00789 in R3.

6.2.2.4.3 Enter VERB 05, NOUN 01 into the LEB CMC DSKY. Press the ENTER pushbutton.

6.2.2.4.4 Enter 01600 into LEB CMC DSKY. Press the ENTER pushbutton. The LEB CMC DSKY shall indicate 00024 in R1, 77664 in R2, and 77576 in R3. Verify.

6.2.2.4.5 Enter the following sequence into the LEB CMC DSKY. *(See Figure 6.2.2.4.5.)*
The results are shown in Figure 6.2.2.4.5.

- a) VERB 21 NOUN 01, ENTER
b) 01600, ENTER
c) +00123. DO NOT Press ENTER

6.2.2.4.5.1 Press the CLEAR pushbutton. R1 shall clear.

6.2.2.4.6 Enter VERB 16 NOUN 16 into the LEB-CMC DSKY. Press the ENTER pushbutton. The Operator Error Light shall light.

6.2.2.4.6.1 Press the RESET pushbutton. The Operator Error light shall extinguish.

6.2.2.4.7 Enter the following sequence into the LEB CMC DSKY. Press the ENTER pushbutton as indicated. The KEY Release Light shall light.

- a) VERB 16, NOUN 20, ENTER
b) VERB

6.2.2.4.7.1 Press the KEY RELEASE pushbutton. The Key Release Light shall extinguish.

6.2.2.4.7.2 Enter VERB 36, into the LEB CMC DKS. Press the ENTER pushbutton.

NOTE: 6.2.2.4.8 does not apply to 2TV-1.

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6.2.2.4.8 Enter the following sequence into the LEB CMC DSKY.

- a) VERB 11 NOUN 10, ENTER
- b) 00032, ENTER

Press the STANDBY pushbutton once and verify that "5XXXX" is displayed in R1. Press the STANDBY pushbutton again and verify that "7XXXX" is displayed in R1. Enter VERB 34 and press the ENTER pushbutton.

6.2.2.4.9 Repeat of 6.2.2.4.1 through 6.2.2.4.4. using the MDC CMC DSKY. The results shall be as specified in 6.2.2.4.4.

6.2.2.5 Uplink and Downlink Checks.

6.2.2.5.1 Enter VERB 36 into K148. Press the ENTER pushbutton, then press ERROR RESET pushbutton.

6.2.2.5.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.

- a. VERB 25 NOUN 01 ENTER
- b. 01600, ENTER
- c. 00000, ENTER
- d. 77777, ENTER
- e. 07254, ENTER
- f. VERB 05 NOUN 01, ENTER
- g. 01600, ENTER

6.2.2.5.3 CMC Registers R1, R2, and R3 display on the CRT shall indicate 00000, 77777, and 07254, respectively.

6.2.2.5.4 Set/verify that the UP TLM switch on the Main Display Panel is set to ACCEPT and that the UP TLM switch on the G&N Control Panel is set to BLOCK.

Verify that the BLOCK UPLINK discrete on the CRT is ON.

6.2.2.5.5 On K-148 insert VERB.

Verify that the VERB indication on the DSKY and CRT does not change.

6.2.2.5.6 Set the UP TLM switch on the G&N Indicator Control Panel to ACCEPT. Verify that the BLOCK UPLINK discrete on the CRT is OFF.

6.2.2.5.7 On K-148 insert VERB 01. Verify that the VERB indication on the DSKY and CRT is 01.

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- 6.2.2.5.8 Set the UP TLM switch on the MAIN DISPLAY Panel to BLOCK. Verify that the BLOCK UPLINK discrete on the CRT is ON.
- 6.2.2.5.9 On K-148 insert VERB. Verify VERB indication on the DSKY and CRT does not change.
- 6.2.2.5.10 Set the UP TLM switch on the MAIN DISPLAY Panel to ACCEPT. Verify that the BLOCK UPLINK discrete on the CRT is OFF.
- 6.2.2.5.11 On K-148 insert VERB 36. Press the ENTER pushbutton.

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6.2.2.7 Parity Fail Test

6.2.2.7.1 Enter the following into the K-Start. Press the ENTER pushbutton after each entry.

- a. VERB 57, ENTER
- b. 00015, ENTER
- c. VERB 21 NOUN 02, ENTER
- d. 01600, ENTER
- e. 33777, ENTER
- f. VERB 25 NOUN 26, ENTER
- g. 04000, ENTER
- h. 01600, ENTER
- i. 00003, ENTER
- j. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate.
The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.7.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.7.3 Enter VERB 36, into the K-START. Press the ENTER pushbutton.

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6.2.2.8 Rupt Lock Test

6.2.2.8.1 Enter the following sequence into the K-Start. Press the ENTER pushbutton after each entry.

- a. VERB 24 NOUN 01, ENTER
- b. 01600, ENTER
- c. 30001, ENTER
- d. 01600, ENTER
- e. VERB 25 NOUN 26, ENTER
- f. 00001, ENTER
- g. 01600, ENTER
- h. 00003, ENTER
- i. VERB 31, ENTER

The RESTART lamps on the MDC and LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.8.2 Press the ERROR RESET pushbutton on the K-START. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.8.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

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6.2.2.9 TC Trap Test

6.2.2.9.1 Enter the following sequence into the K-Start. Press the ENTER pushbutton after each entry.

- a. VERB 21 NOUN 02, ENTER
- b. 01600, ENTER
- c. 01600, ENTER
- d. VERB 25 NOUN 26, ENTER
- e. 04000, ENTER
- f. 01600, ENTER
- g. 00003, ENTER
- h. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.9.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.9.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

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6.2.2.10 Nightwatchman Test

6.2.2.10.1 Enter the following sequence into the K-Start. Press ENTER pushbutton after each entry.

- a. VERB 24 NOUN 01, ENTER
- b. 01600, ENTER
- c. 30001, ENTER
- d. 01600, ENTER
- e. VERB 25 NOUN 26, ENTER
- f. 04000, ENTER
- g. 01600, ENTER
- h. 00003, ENTER
- i. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on MDC and LEB CMC DSKY and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.10.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.10.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

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6.2.2.11 CMC Clock Frequency Test

6.2.2.11.1 Insure that the CMC is in the Standby Mode by verifying that the STBY pushbutton on the DSKY's is lit. If it is not lit enter VERB 60, ENTER into the DSKY. Push and hold the STBY pushbutton until it lights. Verify that the NO ATT and TEMP lamps on the DSKY's light.

6.2.2.11.2 Insure that the IMU 3.2 kc 28V Supply is available on the vertical input to PIPA Scope.

6.2.2.11.3 Insure that the EPUT Meter and preset counter plug-in unit are connected to 115V, 60 cps power.

6.2.2.11.3.1 Permit the EPUT to warm up for the length of time required by the manufacturer's specification.

6.2.2.11.4 Connect the signal output from Oscilloscope 4A4-A1 to the input channel on the EPUT Meter.

6.2.2.11.5 Set the preset counter to indicate 96000.

6.2.2.11.6 Set the EPUT meter to count at the maximum count rate (1 megacycle or greater).

6.2.2.11.7 Adjust the Trigger Level to the point midway between the range over which the counter will normally count.

6.2.2.11.8 Each count cycle shall last approximately 30 seconds. Adjust the display time to permit recording the display on the EPUT.

6.2.2.11.9 Record the results of 10 count-cycles. Calculate the average time per cycle over the 10 cycles. Record the result. The average of the 10 previous readings shall be 30.000000 ± 0.000060 seconds.

6.2.2.11.10 Remove the CMC from Standby Mode by performing the following DSKY operations.

- a. Press and hold the STBY pushbutton until it extinguishes.
- b. Press the RESET pushbutton.
- c. VERB 61, ENTER
- d. VERB 36, ENTER.

NOTE: Restart Lamp may illuminate; if it does, disregard and press RSET on the DSKY.

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- 6.2.2.12 Mark and Mark Reject pushbutton test.
- 6.2.2.12.1 On the G&N Indicator Control panel press and hold MARK pushbutton.
- 6.2.2.12.2 On the DSKY observe
VERB 05 NOUN 31
Row 1 = 00112
Prog Alarm lamp is lighted
Press ERR RSET
- 6.2.2.12.3 Enter the following on K-148

VERB 11 NOUN 10 ENTER
00016 ENTER
- 6.2.2.12.4 Observe that DSKY Row 1 displays 00040.
- 6.2.2.12.5 Release MARK pushbutton
- 6.2.2.12.6 Observe that DSKY Row 1 displays 00000.
- 6.2.2.12.7 Press and hold the REJECT pushbutton on the G&N Indicator Control Panel.
- 6.2.2.12.8 Observe that DSKY Row 1 displays 00100.
- 6.2.2.12.9 Release the REJECT pushbutton.
- 6.2.2.12.10 Observe that DSKY Row 1 displays 00000.
- 6.2.2.12.11 On the DSKY Perform the following operation:

VERB 36 ENTER
- 6.2.2.13 Minimum Impulse Controller Input Test
- 6.2.2.13.1 Enter the following into the DSKY.
- a. VERB 11 NOUN 10, ENTER
b. 00032, ENTER
- 6.2.2.13.2 Set the Minimum Impulse Controller on the Indicator Control Panel to the following position and observe R1 of the DSKY for the proper indications.
- | <u>MIC Position</u> | <u>R1 DSKY Indication</u> |
|---------------------|---------------------------|
| a. Up | 77775 |
| b. Down | 77776 |
| c. Left | 77737 |
| d. Right | 77757 |

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MIC Position

R1 DSKY Indication

- e. Clockwise
- f. Counterclockwise
- g. Neutral

7777s
77767
77777

6.2.2.13.3 Enter VERB 34, ENTER into the DSKY.

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6.2.3 Operate Power On Test

6.2.3.1 IMU Operate Power On

CAUTION: The sequences specified in this test must be adhered to. Deviations may necessitate recalibration of the inertial components.

NOTE: Disregard the GIMBAL LOCK indicator until the completion of step 6.2.3.1.6.

6.2.3.1.1 The following Command Module switches and circuit breakers shall be in the following state:

Right Hand Circuit Breaker Panel

- a. GUIDANCE/NAVIGATION COMPUTER MN A and MN B breakers on (pushed in)
- b. GUIDANCE/NAVIGATION IMU HTR MN A and MN B breakers on (pushed in)
- c. GUIDANCE/NAVIGATION IMU MN A and MN B breakers off (pulled out)
- d. GUIDANCE/NAVIGATION OPTICS MN A and MN B breakers off (pulled out)

LEB Lighting Control Panel

- e. G/N Power - IMU set to OFF
- f. G/N Power - Optics set to OFF

6.2.3.1.2 Switches and selectors on the G & N Indicator control panel shall be set as follows:

- a. OPTICS MODE to MANUAL
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to MED
- d. TELESCOPE TRUNNION to SLAVE to EXT
- e. RETICLE BRIGHTNESS to minimum brightness position

6.2.3.1.3 Adjust the Command Module MDC and LEB Lighting Controls to minimum intensity for proper readout of G & N Displays.

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6.2.3.1.4 Set up the ACE analog recorders to monitor the following measurements (set chart speed to 5 mm/sec):

- a. CG 2117 IGA Servo Error In Phase
- b. CG 2177 OGA Servo Error In Phase
- c. CG 2147 MGA Servo Error In Phase
- d. CG 2112 IG IX Resolver Output Sin
- e. CG 2172 OG IX Resolver Output Sin
- f. CG 2142 MG IX Resolver Output Sin
- g. CG 1040 +120 VDC PIPA Supply DC Level

CAUTION: Before proceeding, insure that the G & N System has been operating in the STANDBY MODE (power configuration as defined in 6.2.3.1) for a minimum period of 2 hours. Exceptions to this requirement are noted in 6.2.5.2.9.

CAUTION NOTE: If the requirements of 6.2.3.1.6 are not met, remove IMU operate power immediately by placing the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

6.2.3.1.5 Perform the following sequence:

- a. Turn on the IMU MN A and MN B circuit breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).
- b. Start Analog Recorders.
- c. Place G/N Power - IMU switch on the LEB Lighting Control Panel to IMU (switch toggle up).

6.2.3.1.6 Immediately begin monitoring the following measurements.

- a. The IMU Operate Power is $\pm 28.8 \pm 3$ VDC (CG 1500). Verify on CRT.
- b. On the recorders, verify that oscillations are not sustained and that a null is achieved within 10 seconds of power application in 6.2.3.1.5 on the following measurements:

CG 2112, IG IX Resolver Output Sin
CG 2142, MG IX Resolver Output Sin
CG 2172, OG IX Resolver Output Sin

- c. On the CRT, verify the following measurements:
CG 2001 X PIPA SG OUTPUT IN PHASE is in saturation
CG 2021 Y PIPA SG OUTPUT IN PHASE is in saturation
CG 2041 Z PIPA SG OUTPUT IN PHASE is in saturation

- d. On the CRT, verify the absence of the +120 VDC PIPA supply (CG 1040) for a period of 90 ± 10 seconds following power application in 6.2.3.1.5. After approximately 100 seconds, the voltage shall read $\pm 120 \pm 6$ VDC.

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- 6.2.3.1.7 Insure that the following alarm lamps are not lighted on G&N LEB Display Panel.
- a. CMC Warning
 - b. ISS Warning
 - c. PGNS Caution

- 6.2.3.1.8 Verify that the PROGRAM ALARM lamp on the DSKY's does not light with VERB 05 NOUN 31 and R1 = 00213 displayed.

- 6.2.3.1.9 The OG, IG, and MG CDU angles shall be 00000±00150. Verify on CRT.

- 6.2.3.1.10 Enter the following into K-148:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

- 6.2.3.1.11 Verify that the following secondary power supply voltages are not flashing on the CRT display.

Table VI. Secondary Power Supply Voltages

Meas. No.	Signal
1 CG 1040	+120 VDC PIPA SUPPLY
2 CG 1051	+20 VDC PIPA SUPPLY
3 CG 1052	-20 VDC PIPA SUPPLY
4 CG 1070	+4 VDC CDU SUPPLY
5 CG 1100	-28 VDC ELECTRONICS
6 CG 1020	+14 VDC CMC SUPPLY
7 CG 1030	+4 VDC CMC SUPPLY
8 CG 1201	IMU 28V 800 CPS 1 pot 0 ph
9 CG 1202	IMU 28V 800 CPS 5 pot ph A
10 CG 1203	IMU 28V 800 CPS 5 pot ph B
11 CG 1331	3.2KC 28V SUPPLY
12 CG 1110	2.5 VDC TM BIAS

- 6.2.3.1.12 15 minutes after the application of IMU OPERATE power record PIPA TEMP (CG 2300) displayed on the CRT.

- 6.2.3.1.13 30 minutes after the application of IMU OPERATE power record BRIC TEMP (CG 2301) displayed on the CRT.

- 6.2.3.1.14 1 hour after the application of IMU OPERATE power monitor and record PIPA TEMP (CG 2300) every 5 minutes for 1 hour. Verify that each reading does not deviate from the average of each signal by more than 0.1°F. On the event recorder verify that CG 2303, IMU BLOWER CURRENT is ON.

- 6.2.3.1.15 When 2 hours have elapsed since the application of IMU OPERATE power record PIPA TEMP. PIPA TEMP shall be 120.5° ±1.5°F. PIPA TEMP shall be within 0.5°F of that recorded in 6.2.3.1.12 and 6.2.3.1.14. If at recorded in 6.2.3.1.12 or 6.2.3.1.14, PIPA TEMP shall be within 0.5°F of that recorded in 6.2.3.1.15.

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6.2.3.2 Optics Power On

6.2.3.2.1 Optics power shall be applied by actuating the G&N OPTICS MN A and OPTICS MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in), and placing G/N Power - OPTICS switch on the LEB Lighting Control Panel to ON.

6.2.3.2.2 OPTICS +28 VDC discrete shall be issued (CG 1533). Verify by observing that the OPTICS lamp on Event Module is illuminated. Verify that the +28 VDC OPTX OPERATE BUS (CG 1530) is +28.8±3 VDC. Record the indication on the CRT.

6.2.3.2.3 Verify the following secondary power supply voltages on the CRT are not flashing:

CG 1211 OPTX 28V 800 CPS 1 pct 0 ph
CG 1212 OPTX 800 CPS 5 pct-90 ph

6.2.3.3 IMU Cage Test

6.2.3.3.1 Enter the following into the DSKY:

- a. VERB 40 NOUN 20, ENTER (wait 3 seconds)
- b. VERB 41 NOUN 20, ENTER
- c. +00200, ENTER
- d. +00200, ENTER
- e. +00200, ENTER

Observe that the NO ATT lamps on the DSKY's light and that CDUX, CDUY, CDUZ on the CRT indicate approximately +00200.

6.2.3.3.2 Set up the Analog Recorder to monitor the following signals:

- a. IG 1X Resolver Output Sine (CG 2112)
- b. MG 1X Resolver Output Sine (CG 2142)
- c. OG 1X Resolver Output Sine (CG 2172)

Start the Analog Recorders.

6.2.3.3.3 On MDC panel 1, press and hold the IMU CAGE switch in the CAGE position. On the Analog Recorder, verify that the 1X Sine signals (CG 2112, CG 2142, and CG 2172) null out at 0.5V rms or less.

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- 6.2.3.3.4 Release the IMU CAGE switch. Disregard any momentary transients on the 1X Resolver Sine signals when the switch is released. Sustained oscillations shall be cause for immediate removal of IMU OPERATE power.
- 6.2.3.3.5 On the CRT verify that CDUX, CDUY and CDUZ are all between +00150 and +35850.
- 6.2.3.3.6 Stop the Analog Recorders.
- 6.2.4 G&N System Power Supplies Test
- 6.2.4.1 Proceed with this test if 6.2.3, Operate Power On Test, has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding with this test. Insure that the IMU Operate Power has been on for at least 15 minutes before proceeding with this test.
- 6.2.4.2 Enter the following sequence into the K-Start. Verb 41 NOUN 20, ENTER; +00000 ENTER; +00000 ENTER, +00000 ENTER.
- 6.2.4.3 Set/Verify the following circuit breakers and switches on the Right Hand Circuit Breaker Panel and LEB.
 - a. COMPUTER MN A to ON (pushed in) and COMPUTER MN B to OFF (pulled out).
 - b. G/N - POWER to AC1
 - c. IMU HTR MNA to ON (pushed in) and IMU HTR MNB to OFF (pulled out).
 - d. IMU MNA to ON (pushed in) and IMU MN B to OFF (pulled out).
 - e. G/N POWER - IMU to IMU
 - f. OPTICS MNA to ON (pushed in) and OPTICS MN B to OFF (pulled out).
 - g. G/N POWER - OPTICS to OPTICS
- 6.2.4.4 Record the voltage indicated on the CRT for the following signals:
 - a. The +28 VDC IMU OPERATE (Buss No. 1) output voltage shall be $+28.8 \pm 3$ VDC (CG 1500).
 - b. The +28 VDC IMU STANDBY (Buss No. 2) output voltage shall be $+28.8 \pm 3$ VDC (CG 1510).
 - c. The +28 VDC CMC OPERATE (Buss No. 3) output voltage shall be $+28.8 \pm 3$ VDC (CG 1520).
 - d. The +28 VDC OPTX OPERATE (Buss No. 4) output voltage shall be $+28.8 \pm 3$ VDC (CG 1530).
 - e. The CG 2221, IGA CDU Coarse Error measurement shall be 0.0 ± 0.68 VRMS
 - f. The CG 2251 MGA CDU Coarse Error measurement shall be 0.0 ± 0.68 VRMS
 - g. The CG 2281 OGA CDU Coarse Error measurement shall be 0.0 ± 0.68 VRMS

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6.2.4.5 Record the voltage indicated on the CRT for the following power supplies:

- a. The +120 VDC PIPA Power Supply output voltage shall be 120 ± 6 VDC (CG 1040).
- b. The +20 VDC PIPA Power Supply output voltage shall be 20.0 ± 1.2 VDC (CG 1051).
- c. The -20 VDC PIPA Power Supply output voltage shall be -20 ± 2 VDC (CG 1052).
- d. The -28 VDC Electronics Power Supply output voltage shall be -28.5 ± 6.0 VDC (CG 1100).

6.2.4.6 The following values shall be measured with the guidance reference clock synchronizing input pulse. Record the voltage indicated on the CRT.

- a. IMU 28V, 800 CPS 1% 0 deg. voltage shall be 28.0 ± 0.6 VAC (CG 1201).
- b. IMU 28V, 800 CPS, 5% PHA - 90 deg. voltage shall be 28.0 ± 1.4 VAC (CG 1202).
- c. IMU 28V, 800 CPS, 5% PHB 0 deg. voltage shall be 28.0 ± 2.1 VAC (CG 1203).
- d. Optics 28V, 800 CPS 1% 0 deg. voltage shall be 28.0 ± 0.6 VAC (CG 1211).
- e. Optics 28V, 800 CPS 5% - 90 deg. voltage shall be 28.0 ± 1.5 VAC (CG 1212).
- f. PH Diff IMU 5% 0 deg. -90 deg. (CG 1207) phase difference shall be $90^\circ \pm 10^\circ$.
- g. Ph Diff Optics 1% IMU 1% (CG1220) phase difference shall be $0^\circ \pm 10^\circ$.

6.2.4.7 Record the voltages indicated on the CRT for the following power supplies:

- a. The +14 VDC CMC Power Supply output voltage shall be $+14.0 \pm 0.4$ VDC (CG 1020).
- b. The +4 VDC CMC Power Supply output voltage shall be $+4.0 \pm 0.2$ VDC (CG 1030).
- c. The +4 VDC CDU Power Supply output voltage shall be $+4.0 \pm 0.2$ VDC (CG 1070).
- d. The +2.5 VDC TM BIAS SUPPLY output voltage shall be $+2.50 \pm 0.05$ VDC (CG 1110).

6.2.4.8 Record the CRT indications for the following measurements:

- a. The 28V, 3200 CPS Power Supply feedback output voltage shall be 28.6 ± 0.6 VRMS (CG 1331).
- b. The phase difference between the 3.2Kc supply and CMC sync shall be $0^\circ \pm 10^\circ$ (CG 1336).
- c. The +14 VDC CMC power Supply RMS noise shall be less than 0.4 volts p-p (CG 1021).
- d. The +4 VDC CMC Power Supply noise peaks shall be less than 0.4 volts p-p (CG 1031).

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- 6.2.4.9 Set/Verify the following circuit breakers and switches on the Right Hand Circuit Breaker Panel and LEB:
- a. G/N POWER-OPTICS to OFF
 - b. OPTICS MN B to ON (pushed in) and OPTICS MN A to OFF (pulled out).
 - c. G/N POWER - IMU to OFF
 - d. IMU MN B to ON (pushed in) and IMU MN A to OFF (pulled out).
 - e. IMU HTR MNA to OFF (pulled out)
 - f. G/N - POWER to OFF
 - g. COMPUTER MN B to ON (pushed in) and COMPUTER MN A to OFF (pulled out).
- 6.2.4.10 Verify that the +28 VDC CMC OPERATE output voltage is $\pm 28.8 \pm 3$ VDC (CG 1520).
- 6.2.4.11 Set the G/N - POWER switch on the LEB to AC2. Set the IMU HTR MN B to ON (pushed in). Verify that the +28 VDC IMU STANDBY output voltage is $\pm 28.8 \pm 3$ VDC (CG 1500).
- 6.2.4.12 Wait until 15 minutes have elapsed since setting G/N POWER - IMU to OFF in 6.2.4.9.c then set the G/N POWER - IMU to IMU. Verify that the +28 VDC IMU OPERATE output Voltage is $\pm 28.8 \pm 3$ VDC. (CG 1500).
- 6.2.4.13 Set the G/N POWER - OPTICS to OPTICS. Verify that the +28 VDC OPTX OPERATE output voltage is $\pm 28.8 \pm 3$ VDC (CG 1530).
- 6.2.4.14 Repeat 6.2.4.5 through 6.2.4.8.
- 6.2.4.15 Set the following circuit breakers to the position indicated:
- a. Set the COMPUTER MN A to ON (pushed in).
 - b. Set the IMU HTR MNA to ON (pushed in).
 - c. Set the IMU MNA to ON (pushed in).
 - d. Set the OPTICS MN A to ON (pushed in).
- 6.2.4.16 Miscellaneous Checks - The following miscellaneous signals are required to supply data for system evaluation in the event of failure, or for trend analysis of system performance. Record the values displayed on the CRT for the following signals.
- a. CG 4300 CMC Temperature
 - b. CG 8020 PIPA Calibration Module Temperature
 - c. CG 8021 IMU 800 CPS 5% Temperature

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6.2.4.17 Verify and record the following signals displayed on the CRT:

- a. +120 VDC PIPA SUP. NOISE RMS shall be less than 1.5 VRMS (CG 1042)
- b. +20 VDC PIPA SUP NOISE RMS shall be less than 1.0 VRMS (CG 1053)
- c. +4 VDC CMC SUP NOISE RMS shall be less than 1.0 VRMS (CG 1071)
- d. +28V IMU OPERATE BUS NOISE RMS shall be less than 1.0 VRMS (CG 1501)
- e. +28V IMU STANDBY BUS NOISE RMS shall be less than 1.0 VRMS (CG 1511)
- f. +28V CMC OPERATE BUS NOISE RMS shall be less than 2.0 VRMS (CG 1521).
- g. +28V OPTX OPERATE BUS NOISE RMS shall be less than 2.0 VRMS (CG 1531).

6.2.4.18 The noise peaks of the following signals are demonstrated on the event lights when the peaks have a rise time between 2 and 50 μ sec and the peak voltage exceeds 5 volts.

- a. +14V CMC SUPPLY NOISE PEAKS (CG 1022)
- b. +4V CMC SUPPLY NOISE PEAKS (CG 1032)
- c. +120 VDC PIPA SUPPLY NOISE PEAKS (CG 1043)
- d. +4 VDC CDU SUPPLY NOISE PEAKS (CG 1072)
- e. +28V IMU OPERATE BUS NOISE PEAKS (CG 1502)
- f. +28V IMU STANDBY BUS NOISE PEAKS (CG 1512)
- g. +28V CMC OPERATE NOISE PEAKS (CG 1522)
- h. +28V OPTX OPERATE NOISE PEAKS (CG 1532)

6.2.4.19 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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6.2.5 General Turn Off and Turn On Procedure

NOTE: This procedure shall be utilized any time after performing 6.1.3 Prepower Application Requirements, 6.2.1, Standby Power On Test, and 6.2.3. Operate Power on Test, to turn on or turn off the G&N System. Appropriate portions of this procedure will be referenced in other tests.

6.2.5.1 Turn Off Procedure

CAUTION: This procedure must be performed in the sequence specified. Failure to adhere to this sequence may require calibration of the inertial components.

6.2.5.1.1 Enter the following sequence into the K-148.

- a. VERB 41 NOUN 20, ENTER
- b. +00000 ENTR
- c. +00000 ENTR
- d. +09000 ENTR

Verify that the GIMBAL LOCK indicator on the DSKY's is illuminated.

6.2.5.1.2 Set the following switches on the G&N Indicator Control Panel to the positions designated.

- a. OPTICS MODE to MANUAL
- b. CONTROLLER MODE to DIRECT
- c. CONTROLLER SPEED to MED
- d. TELESCOPE TRUNNION to SLAVE TO SIX
- e. RETICLE BRIGHTNESS to minimum brightness position

6.2.5.1.3 Set the G/N Power - IMU switch on the LEB Lighting Control Panel to OFF and G&N IMU MN A and MN B circuit breakers on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).

6.2.5.1.4 Decrease the LIGHTS - NUMERICS controls on both the Left Hand Circuit Breaker panel and the LEB Lighting Control Panel to the minimum brightness - OFF position.

6.2.5.1.5 Set the PSAAM power switch on the PSAAM of OFF.

6.2.5.1.6 Set the IMU HTR MN A and MN B circuit breaker on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).

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- 6.2.5.1.7 Set the G&N Power AC1-OFF-AC2 Switch on the Right Hand Circuit breaker panel to OFF and the G&N POWER AC1 and AC2 circuit breakers to OFF (breakers pulled out).
- 6.2.5.1.8 Set the G/N POWER - OPTICS switch on the LEB Lighting Control Panel to OFF and G&N OPTICS MN A and MN B breakers on the Right Hand circuit breaker panel to OFF.
- 6.2.5.1.9 Set the COMPUTER MN A and MN B Circuit breakers on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).
- 6.2.5.1.10 Verify that the ICTC is supplying inertial components heater power to the G&N System. This will be indicated by the following on the PTC.
- a. G&N ON (PTC inhibit) light not illuminated.
 - b. IMU Temp/heater current meter indicates IMU temperature of $130^{\circ} \pm 5^{\circ}\text{F}$.
- 6.2.5.2 Turn ON Procedure
- 6.2.5.2.1 Set or verify the following G&N Indicator Control Panel switches to the position indicated.
- a. CONDITION LAMPS to ON
 - b. OPTICS MODE to MANUAL
 - c. CONTROLLER COUPLING to DIRECT
 - d. CONTROLLER SPEED to LOW
 - e. TELESCOPE TRUNNION to SLAVE to EXT
 - f. RETICLE BRIGHTNESS to minimum brightness position.
- 6.2.5.2.2 Insure that interfacing system EPS and ECS are turned on and operating properly.

CAUTION: The remaining procedure must be followed in sequence specified. Failure to adhere to this sequence may require recalibration of the inertial components.

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- 6.2.5.2.3 Energize the G&N COMPUTER MNA and MNB breakers on the Right Hand Circuit Breaker panel (Breakers pushed in). Enter VERB 61 into K148 and press the ENTER pushbutton. Verify +14 and +4 VDC CMC power supply outputs on CRT display. Voltages shall be +14, 0±0.4 VDC (CG 1029) and +4, 0±0.2 VDC (CG 1030). Verify +14 and +4 VDC CMC power supply outputs on NOTE: Restart Lamp may illuminate; if it does, disregard and press 2 VDC (CG 1031) RSET on the DSKY.
- 6.2.5.2.4 Energize the G&N IMU HTR MNA and MNB breakers on the Right Hand Circuit Breaker panel (breakers pushed in). Insure that the CMC +28 VDC discrete lamp on the Event Module is illuminated (CG 1523).
- 6.2.5.2.5 Set the G&N POWER AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in). Set the G&N POWER AC1-OFF-AC2 switch to AC1.
- 6.2.5.2.5.1 Set the G&N DSKY and Display Panel brightness to the minimum acceptable level by manipulation of LIGHTS - NUMERICS control on both Left Hand circuit breaker panel and LEB Light Control panel.
- 6.2.5.2.5.2 Set/Verify the following switches on the PSAAM.
- PSAAM POWER to ON
 - INHIBIT VOLTAGE FAIL to OFF.
- 6.2.5.2.6 Disregard all alarm indications on the CMC DSKY panels. Enter VERB 36 into K148. Press ENTER pushbutton. Press ERROR RESET pushbutton on K-Start. All computer alarms except the Gimbal Lock Indicator on the Main Display Console (MDC) and LEB AGC DSKY shall clear. Verify registers R1, R2, and R3 on the DSKY's are cleared.
- 6.2.5.2.7 Clear the CMC erasable memory by entering the following sequence into the K-Start.
- VERB 47, press ENTER
 - 00015, press ENTER
- 6.2.5.2.8 Initiate CMC Self-Test by entering the following into the K-Start:
- VERB 21 NOUN 27, ENTER
 - 77777, ENTER
 - VERB 15 NOUN 01, ENTER
 - 01366, ENTER
- 6.2.5.2.8.1 Monitor DSKY until R3 (SCOUNT+2) increments twice. If an error is detected, the following will be displayed:
- VERB 05 NOUN 31
 - R1 = 01102
 - R2 = XXXXX c (SFAIL)
 - R3 = XXXXX c (ERCOUNT)
- 6.2.5.2.8.2 Terminate Self-Test by entering the following into the K-Start:
- VERB 21 NOUN 27, ENTER
 - 00000, ENTER

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NOTE: Allow 2 hours to elapse before proceeding to 6.2.5.2.9 with the following exceptions:

- a. If the G&N System has been in the power off state for less than 5 days with the gimbals in the parked position (0°, 0°, 90°) and the system has not been moved, allow 15 minutes to elapse before proceeding.
- b. If the G&N System has been turned off with the gimbals in the unparked position for less than 2 hours allow a warmup time equal to the time off but not less than 15 minutes to elapse before proceeding.

CAUTION: If the requirements of 6.2.5.2.10 are not met, remove IMU Operate Power immediately by setting the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

6.2.5.2.9

After the required warmup time has elapsed set the G&N IMU MN A and MN B circuit breaker on the Right Hand circuit breaker panel to ON (breaker pushed in), and the G/N POWER - IMU switch on the LEB Lighting Control panel to the ON position (toggle up).

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6.2.5.2.10

Immediately begin monitoring the following measurements.

- a. On the CRT verify that IMU Operate Power is $\pm 28.8 \pm 3$ VDC (CG 1500).
- b. On the meter modules verify that oscillations are not sustained and that a null is achieved within 10 seconds of power application on the following measurements:

CG 2112	IG 1X Resolver Output Sin
CG 2142	MG 1X Resolver Output Sin
CG 2172	OG 1X Resolver Output Sin

- c. On the CRT verify the absence of the +120 VDC PIPA Supply (CG 1040) for a period of 90 ± 10 seconds following power application. After approximately 100 seconds, the voltage shall read $+120 \pm 6$ VDC.

6.2.5.2.11

Verify that the PROGRAM ALARM lamp on the DSKY's does not light with VERB 05 NOUN 31 and R1 = 00213 displayed.

6.2.5.2.12

Enter and verify VERB 40, NOUN 20 into K148. Press the ENTER pushbutton.

6.2.5.2.13

Enter and verify VERB 41, NOUN 20 into K148. Press the ENTER pushbutton to advance the System to the Coarse Align mode. The VERB-NOUN display on the CRT shall flash and indicate 21-22.

6.2.5.2.14

Enter and verify +00000 into K148 three times, pressing the ENTER pushbutton on the K-START after each entry.

6.2.5.2.15

Set the G&N OPTICS MN A and MN B circuit breakers on the Right Hand circuit breaker panel to the ON position (breaker pushed in).

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6.2.5.2.16 Verify that the CRT indications of the signals in Table VI are not flashing.

Table VI. Secondary Power Supply Voltages

Measurement Number	Signal
1 CG 1040	+120 VDC PIPA SUPPLY
2 CG 1051	+20 VDC PIPA SUPPLY
3 CG 1052	-20 VDC PIPA SUPPLY
4 CG 1070	+4 VDC CDU SUPPLY
5 CG 1100	-28 VDC ELECTRONICS
6 CG 1020	+14 VDC CMC SUPPLY
7 CG 1030	+4 VDC CMC SUPPLY
8 CG 1201	IMU 28V 800 CPS 1 pct 0 ph
9 CG 1202	IMU 28V 800 CPS 5 pct ph A
10 CG 1203	IMU 28V 800 CPS 5 pct ph B
11 CG 1331	3.2 KC 28V SUPPLY
12 CG 1110	2.5 VDC TM BIAS
13 CG 2300	PIPA TEMPERATURE

6.2.5.2.17 Monitor the PIPA Display Scope to insure that each PIPA is moding properly.

6.2.5.2.18 Perform 6.2.6 G&N Operational Test.

6.2.5.3 Master Initialization

6.2.5.3.1 Set/Verify the following Circuit Breakers to ON.

- a. G&N COMPUTER MNA & MNB
- b. G&N POWER AC1 & AC2
- c. G&N IMU HTR MNA & MNB

NOTE: If IMU OPERATE POWER is not ON, refer to paragraph 6.2.5.2.9.

- d. G&N IMU MNA & MNB

6.2.5.3.2 Verify/Record the following measurements:

- a. PIPA Temperature (CG 2300) $130 \pm 1.5^\circ\text{F}$.
- b. +28 VDC CMC OPERATE BUS (CG 1520) 28.8 ± 3 VDC.

NOTE: If the GIMBAL LOCK light on the DSKY is lit, proceed to paragraph 6.2.5.3.5.

6.2.5.3.3 Enter VERB 36, ENTER into K148.

6.2.5.3.4 Enter VERB 40 NOUN 20, ENTER into K148.

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6.2.5.3.5 Enter the following into K148:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

Observe the NO ATT lamp lights and the Inner, Outer, and Middle Gimbal angles are 0±1.5° as indicated by the CDUX, CDUY, and CDUZ displays on the CRT.

6.2.5.3.6 Insure that the following switches are set to the positions indicated.

- a. CONTROLLER COUPLING to DIRECT
- b. OPTICS MODE to MAN
- c. TELESCOPE TRUNNION to SLAVE TO SXT
- d. TRACKER to OFF
- e. CONTROLLER SPEED to LO
- f. CONDITION LAMPS to ON
- g. UP TELEMETRY to ACCEPT

6.2.5.3.7 Press the ERROR RESET pushbutton. Enter the following into K148.

- a. VERB 57, ENTER
- b. 00015, ENTER

6.2.6 G&N Operational Test

6.2.6.1 Initial Conditions

Proceed with this test if the Operate Power On Test of 6.2.3 or the Turn on Procedure of 6.2.5 has been completed and system operation has not be interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding.

6.2.6.1.1 Enter the following into K-148:

- a. VERB 01 NOUN 10, ENTER
 - b. 00003, ENTER
- Record R1 = AAAAA and the time of day

6.2.6.1.2 Enter the following into K-148.

- a. VERB 21 NOUN 02, ENTER
 - b. 01300, ENTER
 - c. AAAAA, ENTER (from 6.2.6.1.1)
 - d. VERB 06 NOUN 02, ENTER
 - e. 01300, ENTER
- Record R1 = BBBB

6.2.6.1.3 Perform the following calculations:

- a. $\frac{R1(BBBBB) \times 5.12}{3600} = CC.C$ (hours in high order scaler Channel 03)

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- b. 23.3 - CC.C = DD.D hours
- c. Add DD.D to the time of day recorded in 6.2.6.1.1. This is the time of day at which the high order scalar, channel 03, will overflow.

Do not enter the G&N Operational test within -0.2 hours of the time of day calculated in step 6.2.6.1.3c. If the test is in process at this time, unacceptable test results will occur.

6.2.6.2 Initiation

6.2.6.2.1 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.6.2.2 Enter 00004 into K148. Press the ENTER pushbutton.

6.2.6.2.3 Observe VERB 16 NOUN 10 displayed on CRT. The NO ATT discrete shall appear momentarily then go OFF. Verify that the PROGRAM displayed on the CRT indicates 07.
Enter VERB 34 into K148 and press the ENTER pushbutton.

NOTE: During this portion of the test the G&N System is exercised through its modes. Any failures will be indicated by the PROGRAM ALARM lamp on the DSKY's lighting with VERB 05 NOUN 31 and R1 = 01411 displayed.

6.2.6.2.4 After approximately 12 minutes, VERB 06, NOUN 66 will flash and the value of the gravity vector in cm/sec^2 shall be displayed in R1 and R2 on the CRT. Record these values.

6.2.6.2.5 R1 contains the first five digits of the gravity vector and R2 contains the last five digits. A decimal point shall be between them. The value for the gravity vector shall be $980.00000 \pm 0.00000 \text{ cm/sec}^2$.

6.2.6.2.6 Enter VERB 33 into K148. Press the ENTER pushbutton.

6.2.6.2.7 When VERB 06 NOUN 66 flashes the value of the horizontal earth rate shall be displayed on R1 and R2 on the CRT. Record these values.

6.2.6.2.8 R1 contains the first five digits of earth rate and R2 contains the last five digits. A decimal point shall be placed between them. R1 shall always be 00000. The horizontal earth rate shall be 00000.83000 ± 0.1000 earth rate units.

6.2.6.3 Test Termination

6.2.6.3.1 Enter VERB 36 into K148. Press the ENTER pushbutton.

6.2.6.3.2 Enter VERB 41, NOUN 20 into K148. Press the ENTER pushbutton.

6.2.6.3.3 Enter +00000 into K148 three times. Press the ENTER pushbutton after each entry.

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6.2.7 Gimbal Friction Test

6.2.7.1 Perform Master Initialization, 6.2.5.3, before proceeding.

6.2.7.2 Inner Gimbal Friction Test

6.2.7.2.1 Set up the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

- a. CG 2120 IG TORQUE MOTOR CURRENT
- b. CG 2117 IGA SERVO ERROR IN PHASE
- c. CG 2112 IG 1X RESOLVER OUTPUT SIN
- d. CG 2113 IG 1X RESOLVER OUTPUT COS
- e. CG 2220 IGA CDU FINE ERROR

6.2.7.2.2 Enter the following into K148.

- a. VERB 01 NOUN 01, ENTER
 - b. 00362, ENTER
- Record R1 = XXXXY

6.2.7.2.3 Enter the following into K148.

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table 1 and XXXX is that recorded in 6.2.7.2.2.

TABLE I

Y (From 6.2.7.2.2)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.7.2.4 Enter the following sequence into the K-Start, pushing the ENTER pushbutton after each entry (+360 IG torquing).

- a. VERB 24 NOUN 01, ENTER
- b. 00407, ENTER
- c. 40000, ENTER
- d. 40034, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

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6.2.7.2.5 Enter the following sequence into K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (verify VERB 33 on CRT)

6.2.7.2.6 Start analog recorders.

6.2.7.2.7 Verify that IG Servo Error Quadrature (CG 2108) is 0.0 ± 1.2 VRMS. Observe measurement CG 2112, IG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.

6.2.7.2.8 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 40, NOUN 20, press ENTER
- b. VERB 41, NOUN 20, press ENTER
- c. +00000, press ENTER
- d. +00000, press ENTER
- e. +00000, press ENTER

6.2.7.2.9 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 30 seconds before proceeding.

6.2.7.2.10 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (-360° IG torquing):

- a. VERB 24 NOUN 01 ENTER
- b. 00407, ENTER
- c. 37777, ENTER
- d. 37743, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.2.11 Enter the following sequence into K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (Verify VERB 33 on CRT).

6.2.7.2.12 Start analog recorders.

6.2.7.2.13 Observe measurement CG 2112, IG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.

6.2.7.2.14 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 40, NOUN 20, press ENTER
- b. VERB 41, NOUN 20, press ENTER
- c. +00000, press ENTER
- d. +00000, press ENTER
- e. +00000, press ENTER

6.2.7.2.15 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 30 seconds before proceeding.

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ND1002325 REV E

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SPACE and INFORMATION SYSTEMS DIVISION
12214 LAKEWOOD BLVD. DOWNEY, CALIFORNIA

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6.2.7.3 Outer Gimbal Friction Test

6.2.7.3.1 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

- a. CG 2180 OG TORQUE MOTOR CURRENT
- b. CG 2177 OGA SERVO ERROR IN PHASE
- c. CG 2172 OG 1X RESOLVER OUTPUT SIN
- d. CG 2173 OG 1X RESOLVER OUTPUT COS
- e. CG 2280 OGA CDU FINE ERROR

6.2.7.3.2 Enter the following sequence into the K-Start. Pushing the ENTER pushbutton after each entry (+360° OG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00405, ENTER
- c. 40000, ENTER
- d. 40034, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.3.3 Enter the following sequence into K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.3.4 Start analog recorders

6.2.7.3.5 Observe measurement CG 2172, OG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.

6.2.7.3.6 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 40, NOUN 20, press ENTER
- b. VERB 41, NOUN 20, press ENTER
- c. +00000, press ENTER
- d. +00000, press ENTER
- e. +00000, press ENTER

6.2.7.3.7 Verify that OG Servo Error Quadrature (CG-2166) is $0.0 \pm 1.2V$ -RMS. Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 30 seconds before proceeding.

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6.2.7.3.8 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (=360° OG torquing):

- a. VERB 24, NOUN 01, ENTER
- b. 00405, ENTER
- c. 37777, ENTER
- d. 37743, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.3.9 Enter the following sequence into K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (verify VERB 33 on CRT).

6.2.7.3.10 Start analog recorders.

6.2.7.3.11 Observe measurement CG 2172, OG 1X resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorder.

6.2.7.3.12 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 40, NOUN 20, press ENTER
- b. VERB 41, NOUN 20, press ENTER
- c. +00000, press ENTER
- d. +00000, press ENTER
- e. -06750, press ENTER

6.2.7.3.13 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = -06750, Wait 30 seconds before proceeding.

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6.2.7.4 Middle Gimbal Friction Test

6.2.7.4.1 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

- a. CG 2150 MG TORQUE MOTOR CURRENT
- b. CG 2147 MGA SERVO ERROR IN PHASE
- c. CG 2142 MG LX RESOLVER OUTPUT SIN
- d. CG 2143 MG LX RESOLVER OUTPUT COS
- e. CG 2250 MGA CDU FINE ERROR
- f. CG 2141 MGA CDU FINE ERROR
- g. CG 2140 MGA CDU FINE ERROR
- h. CG 2139 MGA CDU FINE ERROR

6.2.7.4.2 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (+135° MG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00411, ENTER
- c. 63777, ENTER
- d. 77777, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.4.3 Enter the following sequence in the K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.4.4 Start the analog recorder.

6.2.7.4.5 Verify that MG Servo Error Quadrature (CG 2138) is 0.0 ± 1.2 VRMS. Observe measurement CG 2142, MG LX Resolver output SIN, on the analog recorder. When steady-state condition occurs (approximately 5 minutes), stop the recorders.

6.2.7.4.6 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 40 NOUN 01, ENTER
- b. VERB 41 NOUN 20, press ENTER
- c. +00000, press ENTER
- d. +00000, press ENTER
- e. +06750, press ENTER

6.2.7.4.8 Enter the following sequence into the K-Start. Push ENTER pushbutton after each entry (-135° MG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00411, ENTER
- c. 14000, ENTER
- d. 00000, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

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6.2.7.4.9 Enter the following sequence in the K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (Verify VERB 33 on CRT)

622.7.4.10 Start analog recorders.

6.2.7.4.11 Observe measurement CG 2142, MG LX Resolver output SIN, on the analog recorder. When the steady-state condition occurs (approximately 5 minutes), stop the recorders.

6.2.7.4.12 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 36, ENTER
- b. VERB 40 NOUN 20, press ENTER
- c. VERB 41 NOUN 20, press ENTER
- d. +00000, press ENTER
- e. +00000, press ENTER
- f. +00000, press ENTER

6.2.7.5 Examine the traces of the recorded measurements for all six phases of this test to detect any sharp discontinuities. Disregard transients of 0.5 second duration or less on the Gimbal Torque motor current traces, and those less than 0.2 second on the CDU fine error measurement traces. The Gimbal Torque motor currents shall not exceed 0.125 ampere. The CDU Fine Error measurements shall not exceed ± 70 mvrms.

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6.2.8 G&N Panel Brightness and Lamp Test

6.2.8.1 Proceed with this test if 6.2.5.2 or 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 before proceeding with this test.

6.2.8.2 Rotate the RETICLE BRIGHTNESS thumbwheel on the Control Indicator Panel and verify the capability to control the illumination of the following lamps:

- a. SCT reticles
- b. EXT reticles
- c. Telescope Panel Angle Counters

6.2.8.3 Turn on LIGHTS-INTEGRAL control on Left Hand Circuit Breaker panel and LEB Lighting Control Panel.

6.2.8.4 Adjust the brightness controls on the LEB Lighting Control Panel and Left Hand Circuit Breaker Panel from minimum brightness to maximum brightness. Verify the operation of the G&N Indicator Control Panel lamps.

6.2.8.4.1 Re-adjust brightness controls for minimum acceptable lighting. Turn off LIGHTS-INTEGRAL control on Left Hand Circuit Breaker panel and LEB Lighting Control Panel.

6.2.8.5 Push and hold the CONDITION LAMPS switch on the G&N Indicator Control Panel to TEST. Verify the illumination of the following lamps:

- a. STAR ACQ
- b. MASTER ALARM lamp

6.2.8.6 Set the CONDITION LAMPS switch to ON. Lamps a and b in 6.2.8.5... shall extinguish.

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- 3.2.9.1.1 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG1530) is +28.0±3.0 VDC. Record the indication on the CRT. Verify that OPTX 28V 800 cps 1% Oph (CG1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.
- 6.2.9 Semi-Automatic Moding Check Internal. If the mode indicator is in the Semi-Automatic position, the mode indicator will be in the Semi-Automatic position.
- 6.2.9.1 Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.9.1.1 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG1530) is +28.0±3.0 VDC. Record the indication on the CRT. Verify that OPTX 28V 800 cps 1% Oph (CG1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.
- 6.2.9.1.2 Enter VERB 67 into K148. Press the ENTER pushbutton.
- 6.2.9.1.3 Enter 00010 into K148. Press the ENTER pushbutton.
- 6.2.9.1.4 Observe VERB 06 NOUN 01 flashes on the CRT and the PROGRAM display indicates 07.
- 6.2.9.2 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 30 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 02 flashing
 - b. R1 = +00000 ± 00007
 - c. R2 = +00000 ± 00007
 - d. R3 = +00000 ± 00007
 - e. IG angle = 000 ± 1 deg.
 - f. MG angle = 000 ± 1 deg.
 - g. OG angle = 000 ± 1 deg.
- 6.2.9.3 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 03 flashing
 - b. R1 = +04500 ± 00007
 - c. R2 = +04500 ± 00007
 - d. R3 = +04500 ± 00007
 - e. IG angle = 045 ± 1 deg.
 - f. MG angle = 045 ± 1 deg.
 - g. OG angle = 045 ± 1 deg.
- 6.2.9.4 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall extinguish. After approximately 100 seconds the following data shall be displayed on the CRT.
- a. VERB 05 NOUN 30 flashing
 - b. R1 = 00000 ± 00003
 - c. R2 = 00000 ± 00003
 - d. R3 = 00000 ± 00003

NOTE: Negative numbers will be displayed in octal complement form, i.e., -00001 = 77776.

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- 6.2.9.5 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 20 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 06 flashing
 - b. R1 = +07100±00007
 - c. R2 = +07100±00007
 - d. R3 = +07100±00007
 - e. IG angle = 071±1 deg.
 - f. MG angle = 071±1 deg.
 - g. OG angle = 071±1 deg.
- The GIMBAL LOCK lamps on the DSKY's shall light. The PGNS caution lamp on the Indicator Control Panel shall light.
- 6.2.9.6 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 06 flashing
 - b. R1 = +09000±00007
 - c. R2 = +09000±00007
 - d. R3 = +09000±00007
 - e. IG angle = 090±1 deg.
 - f. MG angle = 090±1 deg.
 - g. OG angle = 090±1 deg.
- 6.2.9.7 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 07
 - b. R1 = +13500±00007
 - c. R2 = +13500±00007
 - d. R3 = +13500±00007
 - e. IG angle = 135±1 deg.
 - f. MG angle = 135±1 deg.
 - g. OG angle = 135±1 deg.
- 6.2.9.8 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds VERB 06 NOUN 10 shall flash. The GIMBAL LOCK lamp shall extinguish on the DSKY's. The PGNS caution lamp on the Indicator Control Panel shall extinguish. The gimbal angles shall be approximately 135°, 135°, and 45° respectively.
- 6.2.9.9 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall extinguish. After approximately 100 seconds the following data shall be displayed on the CRT.
- a. VERB 05 NOUN 30 flashing
 - b. R1 = 00000±00003
 - c. R2 = 00000±00003
 - d. R3 = 00000±00003

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6.2.9.10 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 12 flashing
- b. R1 = +22500 ± 00007
- c. R2 = +22500 ± 00007
- d. R3 = +22500 ± 00007
- e. IG angle = 225 ± 1 deg.
- f. MG angle = 225 ± 1 deg.
- g. OG angle = 225 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY's shall light. The PGNS caution lamp on the Indicator Control Panel shall light.

6.2.9.11 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 13 flashing
- b. R1 = +22500 ± 00007
- c. R2 = +22500 ± 00007
- d. R3 = +31500 ± 00007
- e. IG angle = 225 ± 1 deg.
- f. OG angle = 225 ± 1 deg.
- g. MG angle = 315 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY shall extinguish. The PGNS caution lamp on the Indicator Control Panel shall extinguish.

6.2.9.12 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall extinguish. After approximately 100 seconds the following data shall be displayed on the CRT.

- a. VERB 05 NOUN 30 flashing
- b. R1 = 00000 ± 00003
- c. R2 = 00000 ± 00003
- d. R3 = 00000 ± 00003

6.2.9.13 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 15 flashing
- b. R1 = +31500 ± 00007
- c. R2 = +31500 ± 00007
- d. R3 = +31500 ± 00007
- e. IG angle = 315 ± 1 deg.
- f. MG angle = 315 ± 1 deg.
- g. OG angle = 315 ± 1 deg.

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- 6.2.9.14 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY shall extinguish. After approximately 100 seconds the following data shall be displayed on the CRT.
- VERB 06 NOUN 30 flashing
 - $R1 = 00000 \pm 00003$
 - $R2 = 00000 \pm 00003$
 - $R3 = 00000 \pm 00003$
- 6.2.9.15 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 20 seconds the following data shall be displayed on the CRT.
- VERB 06 NOUN 17 flashing
 - $R1 = +28900 \pm 00007$
 - $R2 = +28900 \pm 00007$
 - $R3 = +28900 \pm 00007$
 - IG angle = 315 ± 1 deg.
 - OG angle = 315 ± 1 deg.
 - MG angle = 289 ± 1 deg.
- The GIMBAL LOCK lamp on the DSKY's shall light. The PGNS caution lamp on the Indicator Control Panel shall light.
- 6.2.9.16 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data will be displayed on the CRT.
- VERB 06 NOUN 20 flashing
 - $R1 = +00000 \pm 00007$
 - $R2 = +00000 \pm 00007$
 - $R3 = +00000 \pm 00007$
 - IG angle = 000 ± 1 deg.
 - MG angle = 000 ± 1 deg.
 - OG angle = 000 ± 1 deg.
- The GIMBAL LOCK lamp on the DSKY's shall extinguish. The PGNS caution lamp on the Indicator Control Panel shall extinguish.
- 6.2.9.17 Enter VERB 33 and press the ENTER pushbutton. The COMP ACTY lamp on the DSKY's shall flash for a few seconds. After approximately 15 seconds the following data shall be displayed on the CRT.
- VERB 06 NOUN 66 flashing
 - $R1 = 000xx$
 - $R2 = xxxxx$
- The GIMBAL LOCK lamp on the DSKY's shall light. The PGNS caution lamp on the Indicator Control Panel shall light.
- Record R1 and R2 as the Middle Gimbal CDU drive rate.
MG rate = $\frac{R1}{R2}$ "/sec. The Middle Gimbal CDU drive rate shall be 14 ± 2 "/sec.

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- 6.2.9.18 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 66 flashing
 - b. R1 = 000xx
 - c. R2 = xxxxx
- The GIMBAL LOCK lamp on the DSKY's shall extinguish. The PGNS caution lamp on the Indicator Control Panel shall extinguish.
- Record R1 and R2 as the Inner Gimbal CDU drive rate.
IG rate = $\frac{R1}{R2}$ °/sec. The Inner Gimbal CDU drive rate shall be 14 ± 2 °/sec.
- 6.2.9.19 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 66 flashing
 - b. R1 = 000xx
 - c. R2 = xxxxx
- Record R1 and R2 as the Outer Gimbal CDU drive rate. OG rate = $\frac{R1}{R2}$.
The Outer Gimbal CDU drive rate shall be 14 ± 2 °/sec.
- 6.2.9.20 Enter VERB 33 into K148. The NO ATT lamp on the DSKY's shall extinguish. Press the ENTER pushbutton. After approximately 20 seconds VERB 21 NOUN 22 shall flash on the CRT. Enter +00100 into K148 three times. Press the ENTER pushbutton after each entry. The NO ATT lamp on the DSKY's shall momentarily light, then extinguish. After approximately 100 seconds VERB 01 NOUN 10 flashing shall be displayed on the CRT. Press the ENTER pushbutton.
- Enter 00030 into K148. Press the ENTER pushbutton. Verify R1 = 33xxx.
- The ISS WARNING Lamp on the Indicator Control Panel shall light.
The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be ON.
- 6.2.9.21 Enter VERB 33 into K148. Press the ENTER pushbutton. ISS WARNING and ISS CDU FAIL shall be OFF. After approximately 20 seconds VERB 21 NOUN 22 shall flash on the CRT. Enter +03375 into K148 three times. Press the ENTER pushbutton after each entry. The NO ATT lamp on the DSKY's shall momentarily light, then extinguish. After approximately 100 seconds VERB 01 NOUN 10 flashing shall be displayed on the CRT. Press the ENTER pushbutton.
- Enter 00030 into K148. Press the ENTER pushbutton.
Verify R1 = 33xxx.
- The ISS WARNING lamp on the Indicator Control Panel shall light.
The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be ON.

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6.2.9.22 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 20 seconds VERB 06 NOUN 55 shall flash on the CRT. The ISS WARNING lamp on the Control Indicator Panel shall extinguish. The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be OFF.

6.2.9.23 Set the OPTICS MODE switch on the Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to CMC.

6.2.9.24 Enter VERB 33 into K-148 and press the ENTER pushbutton. After approximately 25 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 66 flashing
- b. R1 = 000xx
- c. R2 = xxxxx

Record R1 and R2 as the Shaft Optics CDU drive rate.

Shaft rate = $\frac{R1}{R2}$. The Shaft Optics CDU drive rate shall be 7.32 ± 1.82 /sec.

6.2.9.25 Enter VERB 33 into K148. Press the ENTER pushbutton. In about 15 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 66
- b. R1 = 0000x
- c. R2 = xxxxx

Record R1 and R2 as the Trunnion Optics CDU drive rate. Trunnion rate = $\frac{R1}{R2}$. The Trunnion Optics CDU drive rate shall be 1.83 ± 0.50 /sec.

6.2.9.26 Terminate the Semi-Automatic Moding Check by entering VERB 34 into K148. Observe PROG display on DSKY's is 00. Press the ENTER pushbutton. Set the G&N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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6.2.10 Zero Optics Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2 Turn On procedure before proceeding.

- 6.2.10.1 Set the G/N POWER - OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $+28.0 \pm 3.0$ VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.
- 6.2.10.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.
- VERB 41, NOUN 20, ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER
- 6.2.10.3 Insure that the following switches on the G&N Indicator Control Panel are set as follows:
- TELESCOPE TRUNNION to SLAVE TO SXT
 - CONTROLLER COUPLING to DIRECT
 - CONTROLLER SPEED to HI
- 6.2.10.4 Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K148. Press the ENTER pushbutton.
- 6.2.10.5 Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following on R1 and R2 of the DSKY.
- $R1 = +0.00^\circ +0.02^\circ, -0.03^\circ$ (Shaft Angle)
 - $R2 = +0.000^\circ +0.006^\circ, -0.007^\circ$ (Trunnion Los Angle)
- Return the OPTICS MODE switch to MAN.
- 6.2.10.6 Set up the Analog Recorder to monitor the following measurements. Use a chart speed of 10 mm/sec.
- CG 3140 SXT Shaft Tach Output
 - CG 3150 SXT Trunnion Shaft Tach Output
 - CG 3160 SCT Shaft Tach Output
 - CG 3170 SCT Trunnion Tach Output
 - CG 3117 SXT Shaft Servo Error in phase
 - CG 3118 SXT Trunnion Servo Error in phase
 - CG 3145 SXT Shaft MTR control winding
 - CG 3155 SXT Trunnion MTR control winding

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- 6.2.10.7 Push the Optics Hand Controller to the right, driving the EXT Shaft until R1 on the DSKY indicate $\pm 180 \pm 1^\circ$. Push the Optics Hand Controller up, driving the EXT Trunnion until R2 on the DSKY indicates $\pm 75 \pm 1^\circ$.
- 6.2.10.8 Start the Analog Recorders and set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.
- 6.2.10.9 Monitor the Analog Recorders until all signals return to null. Stop the Analog Recorders. The elapsed time between the initial and final EXT Tach output null shall be less than 15 seconds. The peak magnitude of the EXT Shaft (CG 3140) and Trunnion (CG 3150) tach outputs shall be 3.3 ± 1.3 VRMS. The peak magnitude of the SCT Shaft Tach Output (CG 3160) shall be 3.3 ± 1.3 VRMS. The peak magnitude of the SCT Trunnion Tach Output (CG 3170) shall be 0.85 ± 0.35 VRMS. The EXT SHAFT (CG 3117) and TRUNNION (CG 3118) Servo Error In PHASE measurements shall each have a maximum magnitude of 2 VRMS. The peak magnitude of the EXT SHAFT (CG 3145) and TRUNNION (CG 3155) MTR Control Winding measurements shall be 0.85 ± 0.35 VRMS.
- 6.2.10.10 Record R1 and R2 on the CRT. The data displayed shall be as follows:
 - a. R1 = 000.00 \pm 000.03
 - b. R2 = 00.000 \pm 00.006
 Enter VERB 34 and press the ENTER pushbutton.
- 6.2.10.11 Record the Telescope Panel Angle Counter indications. The Shaft Angle shall be 0.0 ± 0.11 degrees. The Trunnion Angle shall be 0.0 ± 0.22 degrees.
- 6.2.10.12 Set the OPTICS MODE switch on the G&N Indicator Control Panel to MAN. Set the G/N Power Optics switch on the LEB Lighting Control Panel to OFF.
- 6.2.10.13 Insert the universal tool or equivalent into the Trunnion Tool input and engage drive mechanism (button out). Verify that the trunnion turns by viewing the movement through the SCT eyepiece while turning the tool until the TPAC reads $\pm 5^\circ$. Remove the tool from the trunnion tool input.
- 6.2.10.14 Insert the Universal Tool or equivalent into the Shaft Tool input and engage the drive mechanism (button out). Verify that the Shaft turns by viewing the movement through the SCT eyepiece while turning the tool so that the shaft moves through an angle from 0° to $+3$ to -3 to 0 as indicated on the shaft TPAC. Disengage the shaft drive mechanism (button in) and remove the tool.
- 6.2.10.15 Insert the Universal Tool or equivalent into the Trunnion Tool input. Verify that the Trunnion Turns by viewing the movement through the SCT eyepiece while turning the tool so that the trunnion moves from $\pm 5^\circ$ to -5° and back to zero as indicated on the Trunnion TPAC. Disengage the trunnion drive mechanism (button in) and remove the tool.

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6.2.11 OPTICS Coordinate Transformation Control Test

NOTE: Proceed with this test if 6.2.3 Operate Power on Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding.

6.2.11.1 Set/verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.11.2 Enter the following into the K-Start. Press the ENTER pushbutton after each entry:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.11.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the position indicated.

- a. TELESCOPE TRUNNION to SLAVE TO EXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to HI

6.2.11.4 Set up the analog recorders to monitor the following measurements:

- a. CG 3160 SCT Shaft Tachometer Output
- b. CG 3170 SCT Trunnion Tachometer Output

6.2.11.5 Enter the following into the K-Start to monitor the OPTICS CDU's.

VERB 16 NOUN 55, press ENTER

6.2.11.6 Set the OPTICS MODE switch on the G&N Panel to ZERO. Wait 15 seconds. Return the OPTICS MODE switch to MAN.

6.2.11.7 Using the OPTICS CONTROL STICK, drive the Optics until R1 = +225.00 and R2 = +10.000 on the CRT and the DESKY's.

6.2.11.8 Set the CONTROLLER COUPLING switch on the G&N Panel to RSLV and controller speed switch to MED.

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- 6.2.11.9 Position the movable optics target such that it is centered on the SCT retical pattern, then start the analog recorders at a chart speed of 10 mm/second.
- 6.2.11.10 Quickly displace the OPTICS CONTROL STICK 45 ± 10 degrees in the upper right hand quadrant while sighting on the optics target through the SCT eyepiece. The target shall appear to move in the upper right field of view of the SCT at 45 ± 10 deg. When Target leaves the SCT upper right field of view press MARK pushbutton and immediately record the shaft angle as displayed on R1 of the DSKY. The recorded shaft angle shall be $+225 \pm 10.00$ degrees.
- 6.2.11.11 Enter VERB 34 in the DSKY.
Press the ENTER pushbutton.
- 6.2.11.12 Stop the analog recorder and measure the elapsed time between the initial and the final signal null conditions for the two measurements. The elapsed time shall be 24 ± 6 seconds.
- 6.2.11.13 Set the CONTROLLER COUPLING switch on the G&N Panel to DIRECT and drive the Optics with the OPTICS CONTROL STICK until the shaft and trunnion angles as indicated on the SCT TPAC's are approximately zero. Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN.

NOTE: If Optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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6.2.12

Optics Positional Accuracy Test. Proceed with this test if 6.2.3 Operate Power On Test, or 6.2.5.2, Turn-On Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2, Turn On Procedure, before proceeding.

NOTE: This test requires the use of the G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT StLOS before proceeding. Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.

6.2.12.1

Set/verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Set Tracker switch to OFF. Verify the following:

- +28 VDC OPTX OPERATE BUS (CG 1530) is 28.8 ± 3 VDC. Record the indication on the CRT.
- CG 1211 OPTX 28V 800 cps 1% 0 ph not flashing on CRT.
- CG 1212 OPTX 800 cps 5% - 90 ph not flashing on CRT.

6.2.12.2

Enter the following sequence into the K-Start.

- VERB 41, NOUN 20, ENTER
- +00000, ENTER
- +00000, ENTER
- +00000, ENTER

6.2.12.3

Insure that OPTICS Optics control switches on the G&N Indicator Control Panel are set as follows:

- OPTICS MODE TO MAN
- CONTROLLER SPEED to LO
- CONTROLLER COUPLING to DIRECT
- TELESCOPE TRUNNION to SLAVE TO SXT

6.2.12.4

Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN.

6.2.12.5

Resolution Checks

6.2.12.5.1

Sight through the SXT eyepiece. Using the OPTIC CONTROL STICK, adjust the SXT to obtain the best reflected field of view of the 5-inch autocollimator reticle engravings at the center of the field of view.

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- 6.2.12.5.2 Note that the autocollimator reticle contains a series of lines of different thickness and width. Each set of lines is marked with a number (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines. The SXT resolution shall be at least 10 arc-seconds at the center of the field of view.
- 6.2.12.5.3 Repeat 6.2.12.5.1 and 6.2.12.5.2 using the SCT and the SCT resolution chart. The SCT shall have a resolution of at least 3 arc-minutes at the center of the field of view.
- 6.2.12.6 Slave Telescope Mode Checks
- 6.2.12.6.1 Enter VERB 16 NOUN 55 into the K-Start, Press the ENTER pushbutton.
- 6.2.12.6.2 Set the OPTICS MODE switch on the Control Indicator Panel to ZERO. After 15 seconds return the OPTICS MODE switch to MAN.
- 6.2.12.6.3 Record the SXT Shaft and Trunnion angles as indicated by the TPAC and the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between the TPAC Shaft angle and the Shaft CDU angle shall be $\pm 0.11^\circ$ or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be $\pm 0.22^\circ$ or less.
- 6.2.12.6.4 Using the OPTICS CONTROL STICK and CONTROLLER SPEED switch, drive the SXT Shaft and Trunnion CDU's until R1 = $+035.00 \pm 0.10$ deg. and R2 = $+35.000 \pm 0.100$ deg. Record R1 and R2. Record the Shaft and Trunnion angles as indicated by the TPAC. The difference between the TPAC Shaft angle and Shaft CDU angle shall be $\pm 0.11^\circ$ or less. The difference between the TPAC Trunnion angle and Trunnion CDU angle shall be $\pm 0.22^\circ$ or less.
- 6.2.12.6.5 Set the OPTICS MODE switch to ZERO. After 15 seconds return the OPTICS MODE switch to MAN.
- 6.2.12.6.6 Set the TELESCOPE TRUNNION switch to the 0° position.

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- 6.2.12.6.7 Remove the plug from the base of the SXT eyepiece and install the Adapter Assembly and Portable Light Assembly. Turn on the light.
NOTE: If needed to reduce external light, place a photographers hood over the optics head and retroreflecting prism.
- 6.2.12.6.8 By sighting through the SCT eyepiece, position the Retroreflecting Prism, Model No. A23-200, to span between the SXT StLOS and SCT LOS such that the illumination from the backlight filament is clearly visible at the center of the field of view.
- 6.2.12.6.9 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Using the OPTICS CONTROL STICK, adjust the trunnion CDU to bring the SCT horizontal reticle line into coincidence with the SXT horizontal reticle line. Record the Trunnion CDU angle displayed in R2 as XX.XXX degrees. The difference between this angle and the corresponding angle recorded in 6.2.12.6.3 shall be $\pm 0.2^\circ$ or less.
- 6.2.12.6.10 Replace the Portable Light in the adapter on the SXT eyepiece.
- 6.2.12.6.11 Set the OPTICS MODE switch to ZERO. After 15 seconds return the OPTICS MODE switch to MAN. Set the TELESCOPE TRUNNION switch to SLAVE TO SXT.
- 6.2.12.6.12 Temporarily disable the SCT TRUNNION electrical drive by carefully unscrewing the SCT TRUNNION Manual Drive until it just releases from the panel. Do not rotate further, as this would displace the SCT LOS from the desired reference position.
- 6.2.12.6.13 Remove the Portable Light from the adapter and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in step 6.2.12.6.9. Again using the OPTICS CONTROL STICK, bring the SCT horizontal reticle line into coincidence with the SXT horizontal reticle. Record the Trunnion CDU angle displayed in R2. The difference between this angle and the corresponding angle measured in 6.2.12.6.3 shall be $\pm 0.2^\circ$ or less. Replace the Portable Light Assembly in the adapter.
- 6.2.12.6.14 Replace the SCT TRUNNION Manual Drive in the panel.
- 6.2.12.6.15 Use the OPTICS CONTROL STICK to drive the Trunnion CDU to $+25.000^\circ \pm 0.006^\circ$ as indicated on R2. Maintain the Shaft CDU at $000.00^\circ \pm 0.01^\circ$ as indicated on R1.
- 6.2.12.6.16 Set the TELESCOPE TRUNNION switch to 25°. After 30 seconds has elapsed, record the TPAC Trunnion angle and Trunnion CDU angle displayed in R2. The difference shall be $\pm 0.22^\circ$ or less. Record the Shaft CDU angle displayed in R1.
- 6.2.12.6.17 Temporarily disable the electrical drive to the SCT Trunnion and SCT Shaft by unscrewing the SCT Trunnion and Shaft Manual Drive items until they just release from the panel. Do not rotate further, as this would displace the SCT LOS from the desired reference position.

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- 6.2.12.6.18 Reposition the Retroreflecting Prism so that it is inclined at an angle of 25° downward and spans the SCT LOS and SXT StLOS. Sight into the SCT and adjust the prism so that illumination from the backlight filament is again visible at the center of the field of view. Remove the Portable Light Assembly from the SXT eyepiece adapter and direct the light into the SCT eyepiece while sighting through the SXT eyepiece. Observe the comparison of SCT and SXT reticles. Adjust the Trunnion CDU and Shaft CDU angles with the OPTICS CONTROL STICK to bring the two reticle patterns into coincidence. Record the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between each of these angles and the respective angles recorded in 6.2.12.6.16 shall be ± 0.2 degrees or less.
- 6.2.12.6.19 Replace the SCT Shaft and Trunnion Manual Drive items. Replace the Portable Light Assembly in the adapter. Set the TELESCOPE TRUNNION switch to SLAVE TO SXT. Set the OPTICS MODE switch to ZERO. Wait 15 seconds and then set the OPTICS MODE to MAN. Remove the Retro-reflecting Prism and photographer's hood if used.
- 6.2.12.7 SXT Parallelism Tests
- 6.2.12.7.1 Using the OPTICS CONTROL STICK drive the SXT StLOS Trunnion to $+15.000^\circ \pm 2^\circ$ as indicated in R2 of the DSKY. Maintain a Shaft CDU angle of 000.00 ± 0.01 degrees.
- 6.2.12.7.2 Sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to superimpose the SXT LLOS horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.
- 6.2.12.7.3 Repeat 6.2.12.7.2 twice. Calculate and record the average of the three autocollimator readings.
- 6.2.12.7.4 Set the OPTICS MODE switch to ZERO. After 15 seconds return the OPTICS MODE switch to MAN.
- 6.2.12.7.5 Again sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to bring the SXT StLOS horizontal reticle and autocollimator horizontal filar images to coincide. Record the autocollimator reading.
- 6.2.12.7.6 Repeat 6.2.12.7.5 twice. Calculate and record the average of the three autocollimator readings. The average value obtained here shall not differ from that obtained in 6.2.12.7.3 by more than 10 arc seconds.
- 6.2.12.7.7 Using the OPTICS CONTROL STICK drive the SXT Trunnion angle to $85.000^\circ \pm 5^\circ$ as indicated on R2 of the DSKY. Set the CONTROLLER SPEED to LO and drive the SXT Trunnion to $+90.000^\circ \pm 0.006^\circ$ as indicated on R2 of the DSKY. Insure that the SXT Shaft angle remains at 000.00 ± 0.02 degrees as indicated by R1 on the DSKY.
- 6.2.12.7.8 Sight through the SXT. Two reticle patterns shall be visible. Use the OPTICS CONTROL STICK to adjust the SXT Trunnion angle until the two horizontal reticle lines are coincident. Record the Trunnion CDU angle displayed in R2. The Trunnion CDU angle shall be 90.000 ± 0.010 degrees.

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- 6.2.12.7.9 Remove the Portable Light Assembly and Adapter Assembly from the base of the SXT eyepiece. Replace the SXT eyepiece plug.
NOTE: If Optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.
- 6.2.12.8 Shaft and Trunnion Positional Accuracy Checks.
- 6.2.12.8.1 Set the OPTICS MODE switch to ZERO. After 15 seconds, return the selector to MANUAL.
- 6.2.12.8.2 Sight through the SXT. Using the control stick align the SXT SLOS with optical target No. 1 on the G&N Installation Fixture Model No. A23-071.
- 6.2.12.8.3 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton. Record the value of R1 and R2 displayed on the CRT. Record the Shaft and Trunnion Angles from the TPAC.
- 6.2.12.8.4 Sight through the SXT. Using the control stick align the SXT SLOS with Optical Target No. 2 on A23-071.
- 6.2.12.8.5 Record the value in R1 and R2 on the CRT. Record the Shaft and Trunnion Angles from the TPAC.
- 6.2.12.8.6 Set the OPTICS MODE switch to ZERO. After 15 seconds set the switch to CMC.
- 6.2.12.8.7 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.8 Enter the value recorded from R1 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.9 Enter the value recorded from R2 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.10 Sight through the SXT. The SLOS should be centered on Optical Target No. 1 on A23-071. Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.3 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.11 Enter VERB 41 NOUN 55 into the K-START. Press the ENTER pushbutton.
- 6.2.12.8.12 Enter the value recorded from R1 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.13 Enter the value recorded from R2 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.

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- 6.2.12.8.14 Sight through the SXT. The SLOS should be centered on Optical Target No. 2 on A23-071. Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.5 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.15 Set the OPTICS MODE switch to ZERO. After 18 seconds return the switch to MANUAL.
- 6.2.12.8.16 Enter VERB 41 NOUN 20 into the K-START. Press the ENTER pushbutton. Enter +00000 into the K-START 3 times. Press the ENTER pushbutton after each entry.

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- Optics Slew Rate Test
- 6.2.13** **Optics Slew Rate Test:** Enter 1000.0 Trunnion Slew Rate On Display Screen. Wait 15 seconds. Verify that the data displayed is 1000.0. If not, repeat the test.
- NOTE: Perform Master Initialization 6.2.5.3 before proceeding.** Turn on the power, check the power, and check the power.
- 6.2.13.1** Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $+28.0 \pm 3.0$ VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT. Set Tracker switch to OFF.
- 6.2.13.2** Enter the following sequence into K148. Press the ENTER pushbutton after each entry.
- VERB 41 NOUN 20, ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER
- 6.2.13.3** Verify and/or set the following switches on the G&N Indicator Control Panel to the positions indicated.
- TELESCOPE TRUNNION to SLAVE to SXT
 - CONTROLLER COUPLING to DIRECT
 - CONTROLLER SPEED to HI
- 6.2.13.4** Monitor the OCDU's by entering VERB 16 NOUN 55 into K148. Press the ENTER pushbutton.
- 6.2.13.5** Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify that the data displayed is 0.0. If not, repeat the test. The following data displayed is R2 and R3 on the LCD.
- R2 = +XXX.XX (Exit Angle)
 - R3 = +XXX.XX (Trunnion Slew Rate)
- Set the OPTICS MODE switch on the G&N Indicator Panel to MAN.
- NOTE:** Read & understand step 6.2.13.6 before proceeding. Do not hold Control Stick at upper limit more than 10 seconds, or exceed a trunnion angle of 85°
- Trunnion Slew Rate - HI Speed**
- 6.2.13.6** Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R2 and R3. The data displayed is in the following form:
- R2 = +XX.XXX (Trunnion LOS angle in deg.)
 - R3 = +XXX.XX (Time in seconds)

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6.2.13.7 Perform the following calculations:

- a. Difference between R2 displays = --- (Δ trun. angle)
b. Difference between R3 displays = --- (Δ time)

c.
$$\frac{\Delta \text{ trun. angle}}{\Delta \text{ time}} = \text{--- deg/sec}$$

Δ time

The Trunnion slew rate shall be 10±2 deg/sec.

Shaft Slew Rate - HI Speed

6.2.13.8 Using the Optics Control Stick, drive the Trunnion LOS Angle back to approximately zero degrees as indicated on the TPAC. Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read and understand step 6.2.13.9 before proceeding. Do not hold Control Stick at right limit for more than 10 seconds, or exceed a shaft angle of 250°.

6.2.13.9 Push and hold the Optics Control stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R1 and R3. The data displayed is in the following form.

R1 = + XXX.XX (Shaft angle in deg.)
R3 = + XXX.XX (Time in seconds)

6.2.13.10 Perform the following calculations

- a. Difference between R1 displays = --- (Δ shaft angle)
b. Difference between R3 displays = --- (Δ time)

c.
$$\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \text{--- deg/sec}$$

The Shaft Slew Rate shall be 18.5±3.9 deg/sec.

Trunnion Slew Rate - MED Speed

6.2.13.11 Using the Optics Control Stick, drive the shaft angle back to approximately zero degrees as indicated on the TPAC. Set the OPTICS MODE switch to zero. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to MED.

NOTE: Read & understand 6.2.13.12 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

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6.2.13.12 Push and hold the Optics Control stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 10 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R2 & R3. The data displayed is in the following form:

- a. R2 = ±XX.XXX (Trunnion LOS Angle in degrees)
- b. R3 = +XXX.XX (Time in seconds)

6.2.13.13 Perform the following calculations:

- a. Difference between R2 displays = ____ . ____ (Δ Trunnion Angle)
- b. Difference between R3 displays = ____ . ____ (Δ Time)

$$\frac{\Delta \text{ Trunnion angle }}{\Delta \text{ Time }} = \text{ ____ . ____ deg./sec }$$

Δ Time

The Trunnion slew rate shall be 1.0±0.2 deg./sec.

Shaft Slew Rate - MED Speed

6.2.13.14 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read & understand 6.2.13.15 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.15 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 10 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R1 and R3. The data displayed is in the following form:

- a. R1 = ± XXX.XX (Shaft Angle in degrees)
- b. R3 = + XXX.XX (Time in seconds)

6.2.13.16 Perform the following calculations

- a. Difference between R1 displays = ____ . ____ (Δ Shaft Angle)
- b. Difference between R3 displays = ____ . ____ (Δ Time)

$$\frac{\Delta \text{ Shaft Angle }}{\Delta \text{ Time }} = \text{ ____ . ____ deg./sec }$$

Δ Time

The Shaft Slew Rate shall be 2.0±0.4 deg./sec.

Trunnion Slew Rate - LO Speed

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- 6.2.13.17 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to LO.

NOTE: Read and understand 6.2.13.18 before proceeding. Do not hold control stick at upper limit for more than 30 seconds.

- 6.2.13.18 Push and hold the Optics Control stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 10 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R2 and R3. The data displayed is in the following form:

- a. R2 = XX.XXX (Trunnion LOS Angle in degrees)
- b. R3 = XXX.XX (Time in seconds)

- 6.2.13.19 Perform the following calculations:

- a. Difference between R2 displays = XX.XXX (Δ Trunnion Angle)
- b. Difference between R3 displays = XXX.XX (Δ Time)
- c.
$$\frac{\Delta \text{ Trunnion Angle}}{\Delta \text{ Time}} = \text{--- deg/sec}$$

The Trunnion Slew Rate shall be 0.10 ± 0.02 deg/sec.

Shaft Slew Rate - LO Speed

- 6.2.13.20 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read and understand 6.2.13.21 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

- 6.2.13.21 Push and hold the Optics Control stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 10 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R1 and R3. The data displayed is in the following form:

- a. R1 = XXX.XX (Shaft Angle in degrees)
- b. R3 = XXX.XX (Time in seconds)

- 6.2.13.22 Perform the following calculations:

- a. Difference between R1 displays = --- . --- (Δ Shaft Angle)
- b. Difference between R3 displays = --- . --- (Δ Time)
- c.
$$\frac{\Delta \text{ Shaft Angle}}{\Delta \text{ Time}} = \text{--- deg/sec}$$

The Shaft Slew Rate shall be 0.20 ± 0.04 deg/sec.

- 6.2.13.23 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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- 6.2.14 Stabilization Loop Step Response Test.
- 6.2.14.1 Proceed with this test if the Operate Power On Test of 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding.
- 6.2.14.2 Insure that the Carry-on Command Stimuli Unit, Model No. C14-200, is installed and connected.
- 6.2.14.3 Enter VERB 36 into K148. Press the ENTER pushbutton, then the ERROR RESET pushbutton.
- 6.2.14.4 Inner Gimbal Response Test
- 6.2.14.4.1 Enter code 2032000000 in C-START Module 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2117 IGA SERVO ERROR on 4A1-A3-CH1.
- 6.2.14.4.2 Enter VERB 41 NOUN 20 into K148. Press ENTER pushbutton.
- 6.2.14.4.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.
- 6.2.14.4.4 Enter VERB 42 into K148. Press ENTER.
- 6.2.14.4.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.
- 6.2.14.4.6 Enter 0001 into R154. Verify and execute to apply +28 VDC ACE ENABLE to the PSAAM.
- 6.2.14.4.7 Enter 1000 into R155. Verify and execute to enter a DC step into the IG stabilization loop.
- CAUTION: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.
- 6.2.14.4.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.
- 6.2.14.4.9 Enter 0000 into 4A2-A6-R155; the top part of switch should be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the IG Stabilization Loop. The bottom part of switch shall be extinguished.
- 6.2.14.4.10 After the transient has died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step input and the settling of the error signal to a value equal to ± 5 percent of the original step amplitude. In addition, record the total number of overshoots.

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- 6.2.14.4.10.1 The inner gimbal stabilization loop response time shall be less than 0.1 second.
- 6.2.14.4.10.2 The maximum number of overshoots on the IGA Servo Error signals shall be three.
- 6.2.14.5 Middle Gimbal Response Test
- 6.2.14.5.1 Enter code 2028000000 into C-START MODULE 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2147 MGA SERVO ERROR on 4A1-A3-CH1.
- 6.2.14.5.2 Enter VERB 41 NOUN 20 into K148. Press ENTER.
- 6.2.14.5.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.
- 6.2.14.5.4 Enter VERB 42 into K148. Press ENTER.
- 6.2.14.5.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.
- 6.2.14.5.6 Enter 0100 into 4A2-A6-R155. The top part of switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.
- 6.2.14.5.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the MG Stabilization Loop.
- CAUTION: If the transient caused by the step input does not die within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.
- 6.2.14.5.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.
- 6.2.14.5.9 Enter 0000 into 4A2-A6-R155. The top part of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press XEQ/SEAL pushbutton to remove the step input to the MG stabilization loop.
- 6.2.14.5.10 After the transients have died out, stop the analog recorder. Record the stab loop response time by measuring the time interval between removing the step input and the settling of the error signals to a value equal to ± 5 percent of the original step amplitude. In addition, record the total number of overshoots.
- 6.2.14.5.10.1 The middle gimbal stabilization loop response time shall be less than 0.1 second.
- 6.2.14.5.10.2 The maximum number of overshoots on the MGA Servo Error signals shall be three.

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6.2.14.6 Outer Gimbal Response Test

6.2.14.6.1 Enter code 2026000000 in C-START Module 4A1-A5-C156. Press XEQ/SEAL Pushbutton to call up OG 2177 OGA SERVO ERROR on 4A1-A3-CH1.

6.2.14.6.2 Enter VERB 41 NOUN 20 into K148. Press ENTER.

6.2.14.6.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.

6.2.14.6.4 Enter VERB 42 into K148. Press ENTER pushbutton.

6.2.14.6.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.

6.2.14.6.6 Enter 0010 into 4A2-A6-R155. The top half of the switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.

6.2.14.6.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the OG Stabilization Loops.

NOTE: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/M POWER IMU switch on the LEB Lighting Control Panel to OFF.

6.2.14.6.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.

6.2.14.6.9 Enter 0000 into 4A2-A6-R155. The top half of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the OG Stabilization Loop.

6.2.14.6.10 After the transients have died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step input and the settling of the error signal to a value equal to 25 percent of the original step amplitude. In addition, record the total number of overshoots.

6.2.14.6.10.1 The outer gimbal stabilization loop response time shall be less than 0.1 second.

6.2.14.6.10.2 The maximum number of overshoots on the OGA Servo Error Signals shall be three.

6.2.14.7 Enter VERB 40 NOUN 20 into K148. Press the ENTER pushbutton.

6.2.14.7.1 Enter VERB 41 NOUN 20 into K148. Press the ENTER pushbutton.

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- 6.2.14.7.2 Enter +00000 into K148. Press the ENTER pushbutton.
- 6.2.14.7.3 Enter +00000 into K148. Press the ENTER pushbutton.
- 6.2.14.7.4 Enter +00000 into K148. Press the ENTER pushbutton.



Figure 1: Typical Step Input Response

- 6.2.14.7.5 Enter 0000 into R154. Verify and execute to remove +28 VDC ACE ENABLE.
- 6.2.15 IRIG Scale Factor Test
- 6.2.15.1 Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.15.2 Verify that the IMU OPERATE power has been applied for a minimum of 1 hour, and that at least 1 hour has elapsed since running of the Gimbal Friction Test, 6.2.7.
- 6.2.15.3 Set up the Analog Recorders to monitor the following signals:
- a. CG 2117 IG SERVO ERROR
 - b. CG 2147 MG SERVO ERROR
 - c. CG 2177 OG SERVO ERROR
 - d. CG 2120 IG TM CURRENT
 - e. CG 2150 MG TM CURRENT
 - f. CG 2180 OG TM CURRENT
- 6.2.15.3.1 Start the analog recorder chart drive using a chart speed of 1 mm/sec. The recorder shall run for the duration of 6.2.15.
- 6.2.15.4 Enter VERB 57 into K148. Press the ENTER pushbutton.
- 6.2.15.5 Enter 00005 into K148. Press the ENTER pushbutton.
- 6.2.15.6 VERB 06 NOUN 61 shall flash on CRT and the following displayed in R1 and R2:
- R1 = *XXXXX (some Nav. Base azimuth)
- R2 = *XXXXX (some test site latitude; see Table I)

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- 6.2.15.7 If the values displayed in R1 and R2 are correct, proceed with test, if not perform the following sequence:
- To correct R1, on the K-start enter VERB 21, press ENTER pushbutton, $\pm xxx.xx$, press ENTER ($\pm xxx.xx$ is correct nav. base azimuth).
 - To correct R2, on the K-start enter VERB 22, press ENTER pushbutton, $\pm xx.xxx$, press ENTER (obtain correct site latitude from Table I).

Table I

<u>Site</u>	<u>Latitude</u>
NAA	+33.921
MSC	+29.556
MILA	+28.516

- 6.2.15.8 Verify the correct displays on CRT R1 and R2, then on the K-start enter VERB 33 and press ENTER pushbutton.
- 6.2.15.9 VERB 21 NOUN 30 shall flash on the CRT, requesting a load of the test number.

Enter the desired test number from Table I and press the ENTER pushbutton.

Table I. Test Numbers and Positions for IRIG Tests

<u>Test Number</u>	<u>Gyro Being Tested and Direction of Torque</u>
+00001	-X
+00002	-Y
+00003	+Z
-00001	+X
-00002	+Y
-00003	-Z

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- 6.2.15.10 After 160 seconds VERB 06 NOUN 66 shall flash on the CRT. Record the value displayed in register R1 for the appropriate Test Number in Table 2. The data displayed is the Scale Factor error in parts per million. The recorded Scale Factor error shall not exceed ± 1750 ppm.

Table 2. Display of Test Parameters

<u>Test Number</u>	<u>Symbol</u>	<u>Display in R1</u>
+00001	E-X	±XXXXX
+00002	E-Y	±XXXXX
+00003	E-Z	±XXXXX
-00001	E+X	±XXXXX
-00002	E+Y	±XXXXX
-00003	E+Z	±XXXXX

- 6.2.15.11 Enter VERB 33 into K148. Press the ENTER pushbutton.
- 6.2.15.12 Repeat 6.2.15.9 through 6.2.15.11 until all Test Numbers in Table I have been utilized. When the last test number is entered perform only 6.2.15.9 and 6.2.15.10.
- 6.2.15.13 Enter VERB 34 into K148. Press the ENTER pushbutton.
- 6.2.15.13.1 After completion of all test numbers, stop the analog recorders.
- 6.2.15.14 Enter VERB 40 NOUN 20 in K143. Press the ENTER pushbutton.
- 6.2.15.14.1 Enter VERB 41 NOUN 20 into K148. Press the ENTER pushbutton.
- 6.2.15.14.2 Enter +00000 into K148 three times, pressing the ENTER pushbutton after each entry.
- 6.2.16 IMU Performance Test
- 6.2.16.1 Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.16.2 Enter VERB 01 NOUN 10 into K148. Press the ENTER pushbutton. Enter 00003 into K148. Press the ENTER pushbutton. Record R1 = AAAAA and the time of day.
- 6.2.16.3 Enter VERB 21 NOUN 02 into K148. Press the ENTER pushbutton. Enter 01300 into K148. Press ENTER. Enter AAAAA into K148. Press ENTER.
- 6.2.16.4 Enter VERB 06 NOUN 02 into K148. Press ENTER. Enter 01300 into K148. Press ENTER. Record R1 = BBBB.

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6.2.16.5 Perform the following calculations:

- $R1 (BBBBB) \times 5.12 = CCCC.C$ (hrs. in high order scaler channel 3)
3600
- 23.3 - CCC.C = DDDDD Hrs.
- Add DDDDD to time of day recorded in step 1.

Do Not enter any of the PIPA scale factor tests within -0.2 hours of the time of day calculated in step 6.2.16.5c. This is the time at which the high order scaler, channel 3, will overflow. If a PIPA scale factor test is being performed at this time, unacceptable test results will occur.

6.2.16.6 Verify that the IMU Operate Power has been applied for at least one hour.

6.2.16.7 Test Initiation.

6.2.16.7.1 Enter the following into K148.

- VERB 01 NOUN 01, ENTER
- 00362, ENTER
Record R1 = XXXXY

6.2.16.7.2 Enter the following into K148

- VERB 21 NOUN 01, ENTER
- 00362, ENTER
- XXXXY', ENTER where Y' is determined by Table XV and XXXX is that recorded in 6.2.16.7.1.

TABLE XV

Y (from 6.2.16.7.1)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.16.7.3 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.16.7.4 Enter 00001 into K148. Press the ENTER pushbutton.

6.2.16.7.5 On the CRT, DSKY display verify R1 (Navigation Base Azimuth) and R2 (Site Latitude) are correct.

R1 = XXX.XX (Navigation Base Azimuth)
R2 = XXX.XX (Site Latitude)

* Verify that R1 = correct Navigation Base Azimuth and R2 = correct Site Latitude.

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- 6.2.16.7.6 If values for R1 and R2 are correct, proceed to next step. If values for R1 and R2 are incorrect, enter the following sequence into K-148.

VERB 24 ENTR

+XXX.XX ENTR (Correct navigation base azimuth ± 0.50 deg)

+XX.XXX ENTR (Correct site latitude from Table XX)

Verify values in R1 and R2 are correct

TABLE XX

LOCATION	LATITUDE
NAA	+33.921
MSC	+29.556
MILA	+28.516

- 6.2.16.7.7 On K-148 enter the following sequence:

VERB 33 ENTR

VERB 06 NOUN 66 shall flash

- 6.2.16.7.8 On CRT, DSKY display, verify R1 = +00900 (Time), R2 = +00000 (Test Index No.) and R3 = +00001 (Test Position). If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR

+00900 ENTR (Test Time in Seconds)

+00000 ENTR (Test Index Number)

+00001 ENTR (Test Position Entry)

- 6.2.16.7.9 On K-148 enter the following sequence:

VERB 33 ENTR

- 6.2.16.7.10 In approximately 17 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (+NBDY) Position +00001.

- 6.2.16.7.11 On K-148 enter the following sequence:

VERB 33 ENTR

- 6.2.16.7.12 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT, record R1 and R2 (+X PIPAS) Position +00001. Row 1 is whole part, Row 2 is fractional part, Units are cm/sec.

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6.2.16.7.13 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.2.16.7.14 On CRT DSKY displays, verify R1 = +00900, R2 = +00000, and R3 = +00002.

6.2.16.7.15 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.16 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (-NBDZ) Position +00002.

6.2.16.7.17 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.18 In approximately 90 secs. VERB 06 NOUN 66 shall flash. From the CRT, record R1 and R2 (-X PIPAG) Position +00002.

6.2.16.7.19 On K-148 enter the following sequence:

VERB 21 NOUN 01 ENTR
00407 ENTR
77757 ENTR
VERB 21 NOUN 01 ENTR
00411 ENTR
00020 ENTR
VERB 33 ENTR

6.2.16.7.20 In approximately 67 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (-NBDX + ADIAX) Pos +00002. Record CRT CDU gimbal angle indications and time.

6.2.16.7.21 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.2.16.7.22 On CRT, DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00003.

6.2.16.7.23 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.24 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (-NBCX) Position +00003.

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6.2.16.7.25 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.26 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R1 and R2 (+Z PIPAG) Position +00003.

6.2.16.7.27 On K-148 enter the following sequence:

VERB 34 ENTR

VERB 06 NOUN 66 shall flash

6.2.16.7.28 On the CRT, DSKY display verify R1 = +00900, R2 = 00000, and R3 = +00004.

6.2.16.7.29 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.30 In approximately 17 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (+NBDY +ADSRAY) Position +00004.

6.2.16.7.31 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.32 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R1 and R2 (-Z PIPAG) Position +00004.

6.2.16.7.33 On K-148 enter the following sequence:

VERB 21 NOUN 01 ENTR

00405 ENTR

00020 ENTR

VERB 21 NOUN 01 ENTR

00407 ENTR

77757 ENTR

VERB 33 ENTR

6.2.16.7.34 In approximately 87 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R2 (+NBDZ + ADIAZ) Position +00004. Record CRT CDU gimbal angle indications and time.

6.2.16.7.35 On K-148 enter the following sequence:

VERB 33 ENTR

VERB 06 NOUN 66 shall flash

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- 6.2.16.7.36 From the CRT DSKY display, verify R1 = +00900, R2 = +00000 and R3 = +00005.
- 6.2.16.7.37 On K-148 enter the following sequence:
- VERB 33 ENTR
- 6.2.16.7.38 The PROG alarm and GIMBAL LOCK lamps shall light. Press Error Reset. The PROG alarm lamp shall extinguish.
- 6.2.16.7.39 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R1 and R2 (+Y PIPAG) Position +00005.
- 6.2.16.7.40 On K-148 enter the following sequence:
- VERB 34 ENTR
VERB 06 NOUN 66 shall flash
- 6.2.16.7.41 On the CRT DSKY display, verify R1 = +00900, R2 = +00000 and R3 = +00006.
- 6.2.16.7.42 On K-148 enter the following sequence:
- VERB 33 ENTR
- 6.2.16.7.43 The PROG alarm and GIMBAL LOCK lamps shall light. Press Error Reset. The PROG alarm lamp shall extinguish.
- 6.2.16.7.44 In approximately 90 secs VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R1 and R2. (-Y PIPAG) Position +00006.
- 6.2.16.7.45 On K-148 enter the following sequence:
- VERB 34 ENTR
VERB 06 NOUN 66 shall flash
- 6.2.16.7.46 On the CRT DSKY display, verify R1 = +00900, R2 = +00000 and R3 = +00007.
- 6.2.16.7.47 On K-148 enter the following sequence:
- VERB 33 ENTR
- 6.2.16.7.48 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (+. 707 ADSRAX-NBDX) Position +00007.
- 6.2.16.7.49 On K-148 enter the following sequence:
- VERB 34 ENTR
VERB 06 NOUN 66 shall flash

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- 6.2.16.7.50 On the CRT DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00008.
- 6.2.16.7.51 On K-148 enter the following sequence:
VERB 33 ENTR
- 6.2.16.7.52 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 [.707 (NBDZ+NBDY) +0.5 (ADIAZ-ADIA Y) +0.5 (ADSRA Y + ADSRAZ)] Position +00008.
- 6.2.16.7.53 On K-148 enter the following:
VERB 34 ENTR
VERB 06 NOUN 66 shall flash
- 6.2.16.7.54 On the CRT DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00009.
- 6.2.16.7.55 On K-148 enter the following sequence:
VERB 33 ENTR
- 6.2.16.7.56 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (-NBDZ + .707 ADSRAZ) Position +00009.
- 6.2.16.7.57 On K-148 enter the following sequence:
VERB 34 ENTR
VERB 06 NOUN 66 shall flash
- 6.2.16.7.58 On the CRT DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00010.
- 6.2.16.7.59 On K-148 enter the following sequence:
VERB 33 ENTR
- 6.2.16.7.60 In approximately 12 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R2 [.707 (NBDY-NBDX) +.5 (ADIA Y-ADIA X) +.5 ADSRAZ] Position +00010.
- 6.2.16.7.61 Terminate this test by entering in K-148 the following:
VERB 36 ENTR
- 6.2.16.7.62 On K-148 enter the following sequence:
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR

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6.2.16.10 Calculations

Table XXI

Position No. As Displayed in R3	Quantity Being Measured
+00001	+NBDY +X PIPA G
+00002	+NBDZ -X PIPA G -NBDX + ADIAX
+00003	-NBDX +Z PIPA G
+00004	+NBDY + ADSRAY -Z PIPA G +NBDZ + ADIAZ
+00005	+ Y PIPA G
+00006	- Y PIPA G
+00007	-NBDX + .707 ADSRAX
+00008	.707 (-NBDZ - NBDY) + .5 (ADIAZ - ADIAY) +.5 (ADSRAY + ADSRAZ)
+00009	-NBDZ + .707 ADSRAZ
+00010	.707 (NBDY - NBDX) + .5 (ADIAY - ADIAZ) +.5 (ADSRAX)

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6.2.16.10.1 Measured Values

	Line	Position No.	Step No.	Parameter	Recorded Value
6.2.16.10.1.1	1	+00001	6.2.16.7.10	+NBDY	R2
6.2.16.10.1.2	2	+00001	6.2.16.7.12	+XPIPAG	R1 . R2
6.2.16.10.1.3	3	+00002	6.2.16.7.16	+NBDZ	R2
6.2.16.10.1.4	4	+00002	6.2.16.7.18	-XPIPAG	R1 . R2
6.2.16.10.1.5	5	+00002	6.2.16.7.20	-NBDX + ADIAZ	R2
6.2.16.10.1.6	6	+00003	6.2.16.7.24	-NBDX	R2
6.2.16.10.1.7	7	+00003	6.2.16.7.26	+ZPIPAG	R1 . R2
6.2.16.10.1.8	8	+00004	6.2.16.7.30	+NBDY + ADGRAZ	R2
6.2.16.10.1.9	9	+00004	6.2.16.7.32	-ZPIPAG	R1 . R2
6.2.16.10.1.10	10	+00004	6.2.16.7.36	+NBDZ + ADIAZ	R2
6.2.16.10.1.11	11	+00005	6.2.16.7.38	+YPIPAG	R1 . R2
6.2.16.10.1.12	12	+00006	6.2.16.7.44	-YPIPAG	R1 . R2
6.2.16.10.1.13	13	+00007	6.2.16.7.48	-NBDX + .707ADGRAZ	R2
6.2.16.10.1.14	14	+00008	6.2.16.7.52	.707 (-NBDZ - NBDY) + .5 (ADIAZ - ADIAY) +.5 (ADGRAZ + ADGRAZ)	R2
6.2.16.10.1.15	15	+00009	6.2.16.7.56	-NBDZ + .707ADGRAZ	R2
6.2.16.10.1.16	16	+00010	6.2.16.7.60	.707(NBDY - NBDX) + .5 (ADIAZ - ADIAZ) + .5 ADGRAZ	R2

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6.2.16.10.2 Obtain data from last historical IRIG and PIPA test and complete Table X_{I-1}.

TABLE X_{I-1}

PARAMETER	UNITS	RECORDED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIAX	meru/g	
ADIAY	meru/g	
ADIAZ	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

6.2.16.10.3 Obtain data from the second last historical IRIG and PIPA test and complete Table X_{I-2}.

TABLE X_{I-2}

PARAMETER	UNITS	RECORDED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIAX	meru/g	

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TABLE X₁₋₂ (Continued)

PARAMETER	UNITS	RECORDED VALUE
ADIA Y	meru/g	
ADIA Z	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

6.2.16.10.4 Obtain data from the third last historical IRIG and PIPA test and complete Table X₁₋₃.

TABLE X₁₋₃

PARAMETER	UNITS	RECORDED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIA X	meru/g	
ADIA Y	meru/g	
ADIA Z	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

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6.2.16.10.5 Compute the PIPA Scale Factor error in parts per million and record in Table X.

$$\begin{aligned} \text{a. PIPA S. F. Error} &= \left[\frac{(2 \text{ local g})}{+PIPAG - (-PIPAG)} - 1.000000 \right] 10^6 \\ \text{b. X PIPA S. F. Error} &= \left[\frac{(2 \text{ local g})}{\text{line 2} - \text{line 4}} - 1.000000 \right] 10^6 \\ \text{c. Y PIPA S. F. Error} &= \left[\frac{(2 \text{ local g})}{\text{line 11} - \text{line 12}} - 1.000000 \right] 10^6 \\ \text{d. Z PIPA S. F. Error} &= \left[\frac{(2 \text{ local g})}{\text{line 7} - \text{line 9}} - 1.000000 \right] 10^6 \end{aligned}$$

The PIPA S. F. Error shall not exceed ± 1900 PPM.

6.2.16.10.6 Compute the PIPA Bias in cm/sec^2 and record in Table X₁.

$$\begin{aligned} \text{a. PIPA Bias} &= \frac{+PIPAG + (-PIPAG)}{2} = \text{---} \text{ cm/sec}^2 \\ \text{b. X PIPA Bias} &= \frac{\text{line 2} + \text{line 4}}{2} = \text{---} \\ \text{c. Y PIPA Bias} &= \frac{\text{line 11} + \text{line 12}}{2} = \text{---} \\ \text{d. Z PIPA Bias} &= \frac{\text{line 7} + \text{line 9}}{2} = \text{---} \end{aligned}$$

The PIPA Bias shall not exceed $\pm 2.28 \text{ cm/sec}^2$.

6.2.16.10.7 Calculate NBD, ADSRA, and ADIA and record in Table X₁.

$$\begin{aligned} \text{a. NBDX} &= -(\text{line 6}) = \text{---} \\ \text{NBDY} &= \text{line 1} = \text{---} \\ \text{NBDZ} &= \text{line 3} = \text{---} \\ \text{NBD} &\text{ shall not exceed } \pm 15 \text{ meru.} \\ \text{b. ADSRAX} &= \frac{(\text{line 13} - \text{line 6})}{.707} = \text{---} \\ \text{ADSRAY} &= \text{line 8} - \text{line 1} = \text{---} \\ \text{ADSRZ} &= \frac{\text{line 15} + \text{line 3}}{.707} = \text{---} \end{aligned}$$

ADSRA shall not exceed $\pm 40 \text{ meru/g.}$

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c. ADIAX = line 5 - line 6

$$ADIA Y = \text{line } 16 - \frac{.707 (\text{NBDY} - \text{NBDX}) - .5 (\text{ADSRAX} - \text{ADIAX})}{.5}$$

ADIAZ = line 10 - line 3

ADIA shall not exceed ± 100 meru/g.

TABLE X₁

PARAMETER	UNITS	CALCULATED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIAX	meru/g	
ADIA Y	meru/g	
ADIAZ	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

6.2.16.10.8 Perform the following calculations for each term in Table X₁, and record the results in Table D.

$$D_1 = |X_{i-1} - X_i|$$

$$D_2 = |X_{i-1} - X_i| + |X_{i-2} - X_{i-1}|$$

$$D_3 = |X_{i-3} - X_{i-2}| + |X_{i-2} - X_{i-1}| + |X_{i-1} - X_i|$$

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X_1 = data point just obtained
 X_{i-1} = last historical data point
 X_{i-2} = second last historical data point
 X_{i-3} = third last historical data point

NOTE: D_1 calculations begin with the first data point after ISS Pre-Vib; D_2 calculations begin with the second data point after ISS Pre-Vib; D_3 calculations begin with the third data point after Pre-Vib.

TABLE D

PARAMETER	UNITS	D_1	MAX	D_2	MAX	D_3	MAX
NBDX	meru		6		9		11
NBDY	meru		6		9		11
NBDZ	meru		6		9		11
ADSRAX	meru/g		14		21		25
ADSRAY	meru/g		14		21		25
ADSRAZ	meru/g		14		21		25
ADLAX	meru/g		17		33		40
ADLAY	meru/g		17		33		40
ADLAZ	meru/g		17		33		40
X PIPA S. F. Error	PPM		400		500		600
Y PIPA S. F. Error	PPM		400		500		600
Z PIPA S. F. Error	PPM		400		500		600
X PIPA Bias	cm/sec ²		0.5		0.7		0.9
Y PIPA Bias	cm/sec ²		0.5		0.7		0.9
Z PIPA Bias	cm/sec ²		0.5		0.7		0.9

6.2.16.10.9 Failure to meet the above criteria shall result in retest according to paragraph 5.4.2.

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- 6.2.17.1 SXT-NB-IMU Fine Alignment Test
- 6.2.17.1 Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.17.2 Prior to performing this test, the G&N Installation Qualification fixture shall be installed on the supporting fixture and adjusted to permit proper operation of the G&N optics. The azimuth supplied by the azimuth autoset (Optical Reference No. 1) shall be known to ± 30 minutes of arc.

NOTE: The G&N shall have had OPERATE power applied for a minimum of 1 hour. Set the G/N POWER-OPTICS switch to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $+28.0 \pm 3.0$ VDC. Verify that the OPTX 28V 800 cps 1% zero (CG1211) and OPTIX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.

- 6.2.17.3 Enter VERB 01 NOUN 10 into K148. Press the ENTER pushbutton. Enter 00003 into K148. Press the ENTER pushbutton. Record R1 = AAAAA.

If the recorded value is within any of the sets of limits given in Table 1 proceed with the test. If the recorded value is NOT within any of the sets of limits wait 30 minutes and then repeat this step.

TABLE 1

MIN VALUE				MAX VALUE
00000	<	AAAAA	<	03242
04000	<	AAAAA	<	07242
10000	<	AAAAA	<	13242
14000	<	AAAAA	<	17242
20000	<	AAAAA	<	23242
24000	<	AAAAA	<	27242
30000	<	AAAAA	<	33242
34000	<	AAAAA	<	37242

- 6.2.17.4 Enter the following sequence into the Lower Equipment Bay (LEB) DSKY.

- VERB 41 NOUN 20 ENTER
- +00000, ENTER
- +00000, ENTER
- +00000, ENTER

- 6.2.17.5 On the G&N Indicator Control Panel set the following switches to the position indicated.

- TELESCOPE TRUNNION to SLAVE to SXT
- CONTROLLER COUPLING to DIRECT
- CONTROLLER SPEED to LO
- OPTICS MODE to MAN

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- 6.2.17.6 Enter the following into the DSKY.
- a. VERB 01 NOUN 01, ENTER
 - b. 00362, ENTER
- Record R1 = XXXXY
- 6.2.17.7 Enter the following into the DSKY
- a. VERB 21 NOUN 01, ENTER
 - b. 00362, ENTER
 - c. XXXXY', ENTER where Y' is determined by Table II and XXXX is that recorded in 6.2.17.9.

TABLE II

Y (From 6.2.17.9)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

- 6.2.17.8 Initiate the test by entering the following sequence into the LEB DSKY.
- a. VERB 57, ENTER
 - b. 00003, ENTER
- 6.2.17.9 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data is displayed in R1 and R2 on the DSKY.
- a. R1 = +13500
 - b. R2 = +xx.xxx (Site Latitude from Table I)

TABLE I

Test Site	Latitude
NAA	+33.922
MILA	+28.516
MSC	+29.556

- 6.2.17.10 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If the value displayed is other than +13500 in R1 and the correct Site Latitude in R2, correct the data by entering the following sequence into the DSKY.
- a. VERB 21, ENTER
 - b. +13500, ENTER
 - c. VERB 22, ENTER
 - d. +xx.xxx, ENTER (+xx.xxx = Site Latitude from Table I)
 - e. VERB 33, ENTER
- 6.2.17.11 Observe VERB 21 NOUN 30 flashing on the DSKY. Enter the following sequence into the DSKY.
- a. +00001, ENTER (Position Number)
 - b. +00000, ENTER
 - c. +00001, ENTER

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- 6.2.17.12 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Y_{NB} Azimuth)
 - R2 = ±xx.xxx (Y_{NB} Elevation)
 - R3 = 00001
- 6.2.17.13 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct YNB azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx ± 002.00 degrees, ENTER (Y_{NB} azimuth)
 - +xx.xxx ± 02.000 degrees, ENTER (Y_{NB} elevation)
 - VERB 33, ENTER
- 6.2.17.14 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Z_{NB} Azimuth)
 - R2 = ±xx.xxx (Z_{NB} Elevation)
 - R3 = 00002
- 6.2.17.15 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct ZNB azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx ± 002.00 degrees, ENTER (Z_{NB} Azimuth)
 - +xx.xxx ± 02.000 degrees, ENTER (Z_{NB} elevation)
 - VERB 33, ENTER
- 6.2.17.16 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Target 1 Azimuth)
 - R2 = ±xx.xxx (Target 1 Elevation)
 - R3 = 00001
- 6.2.17.17 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct azimuth and elevation for Target 1, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx ± 000.10 degrees, ENTER (Target 1 Azimuth)
 - ±xx.xxx ± 00.010 degrees, ENTER (Target 1 Elevation)
 - VERB 33, ENTER
- 6.2.17.18 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Target 2 Azimuth)
 - R2 = ±xx.xxx (Target 2 Elevation)
 - R3 = 00002

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6. 2. 17. 19 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct azimuth and elevation for Target 2, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xxx000.10 degrees, ENTER (Target 2 Azimuth)
 - +xx.xxx00.010 degrees, ENTER (Target 2 Elevation)
 - VERB 33, ENTER
6. 2. 17. 20 Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds and return the OPTICS MODE switch to MAN. After 90 seconds observe the DSKY for VERB 51 NOUN 30 flashing and R1 = 00001. Set the Optics Mode switch to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.
6. 2. 17. 21 Using the Optics Hand Controller, align the SXT StLos with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.
6. 2. 17. 22 After 90 seconds observe the DSKY for VERB 51 NOUN 30 flashing and R1 = 00002. Set the Optics Mode switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.
6. 2. 17. 23 Using the Optics Hand Controller, align the SXT StLos with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.
- NOTE: The following two MARKS must be performed as quickly as possible. In no case shall the time between the first and second MARK exceed two minutes.
6. 2. 17. 24 Repeat steps 6. 2. 17. 20 through 6. 2. 17. 23.
6. 2. 17. 25 In approximately 7 minutes VERB 06 NOUN 66 shall flash on the DSKY and the test results shall be displayed. R1 and R2 on the DSKY shall display the misalignment of one of the horizontal PIPA's in arc seconds (R1=whole, R2=fractional). Record R1 and R2. (See Table II for PIPA displayed).
6. 2. 17. 26 Enter VERB 33 ENTER into the DSKY. When VERB 06 NOUN 66 flashes R1 and R2 on the DSKY shall display the misalignment of the second horizontal PIPA in arc seconds (R1 whole, R2 fractional). (See Table II for PIPA displayed.) Record R1 and R2.
6. 2. 17. 27 Enter VERB 34 ENTER into the DSKY to terminate the test. Wait 5 seconds.
6. 2. 17. 28 Repeat steps 6. 2. 17. 3 and 6. 2. 17. 8 through 6. 2. 17. 27 substituting No. 00002 in 6. 2. 17. 11, a.
6. 2. 17. 29 Enter the following into the DSKY.
- VERB 36, ENTER
 - VERB 41 NOUN 20, ENTER
 - +00000, ENTER
 - +00000, ENTER

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Table II. Display Conditions at Test Completion

Position	SM Orientation			Horizontal Misalignment Component	
	X _{SM}	Y _{SM}	Z _{SM}	6.2.17.25	6.2.17.26
1	UP	SW	SE	Y _{SM}	Z _{SM}
2	SE	SW	DN	X _{SM}	Y _{SM}
3*	SE	UP	SW	X _{SM}	Z _{SM}

* Position 3 is not run in the Spacecraft because of GIMBAL LOCK considerations.

6.2.17.30 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.17.31 Calculations

- 6.2.17.31.1 a. Y_{SM} misalignment = () $\frac{R1-R2}{}$
 b. Z_{SM} misalignment = () $\frac{R1-R2}{}$
 c. X_{SM} misalignment = () $\frac{R1-R2}{}$
 d. Y_{SM} misalignment = () $\frac{R1-R2}{}$

6.2.17.31.2 Enter the latest values from 6.2.16 IMU Performance Test.

- a. X PIPA bias = _____ cm/sec²
 b. Y PIPA bias = _____ cm/sec²
 c. Z PIPA bias = _____ cm/sec²
 d. $\theta_x = 210$ (X PIPA bias) = _____ arc sec.
 e. $\theta_y = 210$ (Y PIPA bias) = _____ arc sec.
 f. $\theta_z = 210$ (Z PIPA bias) = _____ arc sec.

- 6.2.17.31.3 a. Y_{SM} misalignment (Bias corrected) = 6.2.16.34.1a - θ_y = _____ arc sec.
 b. Z_{SM} misalignment (Bias corrected) = 6.2.16.34.1b - θ_z = _____ arc sec.
 c. X_{SM} misalignment (Bias corrected) = 6.2.16.34.1c - θ_x = _____ arc sec.
 d. Y_{SM} misalignment (Bias corrected) = 6.2.16.34.1d - θ_y = _____ arc sec.

The SM misalignments in each orientation, excluding PIPA bias, shall not exceed ± 150 arc seconds.

6.2.18 Gyrocompassing Test

NOTE: Perform Master Initialization 6.2.5.3 before proceeding.

- 6.2.18.1 Set the G/N POWER-OPTICS Switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $\pm 28.0 \pm 3.0$ VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90°h (CG 1212) are not flashing on the CRT.

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- 6.2.18.2 Enter the following into the DSKY.
- a. VERB 01 NOUN 01, ENTER
 - b. 00362, ENTER
 - Record R1 = XXXXY
- 6.2.18.3 Enter the following into the DSKY.
- a. VERB 21 NOUN 01, ENTER
 - b. 00362, ENTER
 - c. XXXXY', ENTER where Y' is determined by Table II and XXXX is that recorded in 6.2.18.2.

Table II

Y (From 6.2.18.2)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

- 6.2.18.4 Enter the following sequence into the K-Start, pressing ENTER pushbutton after each entry.
- a. VERB 57, ENTER
 - b. 00006, ENTER
- 6.2.18.5 System shall advance to Gyrocompass System Test and display 01 on the CRT program display.
- 6.2.18.6 On the CRT observe VERB 06, NOUN 61 flashing with some launch azimuth displayed in R1 = +xxx.xx.
- 6.2.18.6.1 If the azimuth displayed is correct proceed to 6.2.18.6; if not, perform the following sequence:
- a. VERB 21, Press ENTER pushbutton
 - b. +xxx.xx, press ENTER pushbutton (Correct Launch Azimuth)
- 6.2.18.7 After verifying that the correct launch azimuth is displayed in R1 on the CRT, Enter VERB 33 on the K-START and push the ENTER pushbutton.
- 6.2.18.8 Observe VERB 06 NOUN 61 flashing on the CRT with the following displayed in R1 and R2.
- a. R1 = +xxx.xx, Nav. Base Azimuth (Z_{NB})
 - b. R2 = +xx.xxx, Site Latitude
- 6.2.18.8.1 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence:
- To correct R1:
- a. VERB 21, ENTER
 - b. +xxx.xx±000.50 degrees, ENTER (Z_{NB} Azimuth)
- To correct R2:
- a. Verb 22, ENTER
 - b. +xx.xxx, ENTER (Correct Site Latitude from Table I)

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- 6.2.18.9 After the correct data for R1 and R2 are verified enter VERB 33 into the K-Start. Press the ENTER pushbutton. On the CRT observe the PROGRAM display change to 05 after approximately 90 seconds. After approximately 15 minutes, observe the PROGRAM display change to 02.
- 6.2.18.10 After 120 minutes set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.11 Enter VERB 52 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT change to 03.
- 6.2.18.12 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 1 azimuth and elevation.
- R1 = +xxx.xx (Target 1 azimuth)
 - R2 = +00.000 (Target 1 elevation)
- 6.2.18.13 Verify the data appearing in R1 and R2 and if correct, proceed. If not correct, perform the following sequence.
- VERB 24, ENTER
 - +xxx.xx + 000.01, ENTER (Target 1 azimuth)
 - +00.000, ENTER (Target 1 elevation)
- 6.2.18.14 After the correct readings for R1 and R2 are verified, enter VERB 33 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.15 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 2 azimuth and elevation.
- R1 = +xxx.xx (Target 2 azimuth)
 - R2 = +00.000 (Target 2 elevation)
- 6.2.18.16 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence.
- VERB 24, ENTER
 - +xxx.xx + 000.01, ENTER (Target 2 azimuth)
 - +00.000, ENTER (Target 2 elevation)
- 6.2.18.17 After the correct readings for R1 and R2 are verified enter VERB 33 into the K-Start. Press the ENTER pushbutton.

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- 6.2.18.18 On the G&N Indicator Control Panel set the OPTICS MODE switch to MAN and the CONTROLLER SPEED to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target 1.
- 6.2.18.19 Set the CONTROLLER SPEED switch on the G&N Indicator Control Panel to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 1 and press the MARK pushbutton. If satisfied that the MARK was good, proceed. If not satisfied with MARK, press the MARK REJECT pushbutton and repeat the step.
- 6.2.18.20 Set the CONTROLLER SPEED switch to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target 2.
- 6.2.18.21 Set the CONTROLLER SPEED switch to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 2 and press the MARK pushbutton. If satisfied that the MARK was good, press the ENTER pushbutton. If not satisfied, press the MARK REJECT pushbutton and repeat this step.
- 6.2.18.22 On the CRT observe the following data displayed:
- a. VERB 06 NOUN 60
 - b. R1 = $\pm xx.xxx$ (X gyre elevation error, degrees)
 - c. R2 = $\pm xx.xxx$ (Y gyre elevation error, degrees)
 - d. R3 = $\pm xx.xxx$ (Z gyre azimuth error, degrees)
- Record R1, R2 and R3.
- 6.2.18.23 Enter VERB 34 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT and DSKY's indicates 02. Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.24 Repeat steps 6.2.18.11 through 6.2.18.23 for the next hour at the following intervals.
- a. 15 minutes
 - b. 30 minutes
 - c. 45 minutes
 - d. 60 minutes

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- 6.2.18.25 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.26 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start three times. Press the ENTER pushbutton after each entry. Set the G/N POWER-OPTICS Switch on the LEB Lighting Control Panel to OFF.

6.2.18.27 Data Sheet

Line	Step No.	Parameter	Recorded Value
	6.2.18.22		
1		X Gyre Elevation Error	+ <u>R1</u> degrees
2		Y Gyre Elevation Error	+ <u>R.2</u> degrees
3		Z Gyre Azimuth Error	+ <u>R.3</u> degrees
	6.2.18.24.a		
4		X Gyre Elevation Error	+ <u>R.1</u> degrees
5		Y Gyre Elevation Error	+ <u>R.2</u> degrees
6		Z Gyre Azimuth Error	+ <u>R.3</u> degrees
	6.2.18.24.b		
7		X Gyre Elevation Error	+ <u>R.1</u> degrees
8		Y Gyre Elevation Error	+ <u>R.2</u> degrees
9		Z Gyre Azimuth Error	+ <u>R.3</u> degrees
	6.2.18.24.c		
10		X Gyre Elevation Error	+ <u>R.1</u> degrees
11		Y Gyre Elevation Error	+ <u>R.2</u> degrees
12		Z Gyre Azimuth Error	+ <u>R.3</u> degrees
	6.2.18.24.d		
13		X Gyre Elevation Error	+ <u>R.1</u> degrees
14		Y Gyre Elevation Error	+ <u>R.2</u> degrees
15		Z Gyre Azimuth Error	+ <u>R.3</u> degrees

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6.2.18.28 Calculations Sheet

6.2.18.28.1 Record the most recent values of the following coefficients from 6.2.16, IMU Performance Test.

- a. NBDX = () _____
- b. NBDY = () _____
- c. NBDZ = () _____
- d. ADIAZ = () _____
- e. ADSRAY = () _____

6.2.18.28.2 Perform the following calculations. (Cos λ functions are provided in Table I.)

- a. $D_{(vert)} = NBDX + ADIAZ$
 $D_{(vert)} = () \text{ meru}$
- b. $D_{(east)} = \frac{\sin(\text{Launch Az})}{\cos(\text{Launch Az})} \frac{NBDX}{NBDY + ADSRAY}$
- c. $\phi_{(vert)} = \frac{D_{(vert)} \times \frac{12.8}{\cos \lambda} + D_{(east)} \times \frac{206}{\cos \lambda}}{3600}$
 $\phi_{(vert)} = () \text{ meru}''$

Table I

Location	Latitude λ	Cos λ
NAA	33.921	0.82985
MILA	28.516	0.87868
MSC	29.556	0.86993

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6.2.18.28.3

Perform the following calculations using the recorded data from 6.2.18.27 and 6.2.18.28.2.

- a. Z Gyre azimuth error 2 hrs (corrected) = line 3 - ϕ (vert)
 Z Gyre azimuth error 2 hrs (corrected) = _____
 Corrected Z Gyre azimuth error (corrected) shall be 0.00
 + 0.57 degrees
- b. X Gyre elevation error (2 hr) = line 1
 X Gyre elevation error (2 hr) = _____ degrees
- c. Y Gyre elevation error (2 hr) = line 2
 Y Gyre elevation error (2 hr) = _____ degrees
 The X and Y Gyre elevation errors shall be
 0.00 + 0.08 degrees.
- d. Δ Z Gyre azimuth error (3 hr) = line 3 - line 15
 Δ Z Gyre azimuth error (3 hr) = _____ degrees
 Δ Z Gyre azimuth error shall be 0.00 + 0.06 degrees.
- e. Δ X Gyre elevation error (3 hr) = line 1 - line 13
 Δ X Gyre elevation error (3 hr) = _____ degrees
- f. Δ Y Gyre elevation error (3 hr) = line 2 - line 14
 Δ Y Gyre elevation error (3 hr) = _____ degrees
 Δ X and Δ Y Gyre elevation error shall be 0.00 + 0.03 degrees.

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6.2.19 CMC Voltage Margin Test

6.2.19.1 Verify that the G&N IMU HTR MNA and MNB breakers are engaged, computer MNA and MNB breakers are engaged, IMU MNA and MNB breakers are not engaged, and the G&N Power-IMU switch on the LEB Lighting Control Panel is in the OFF position.

6.2.19.2 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to ON.

Caution: During the performance of this test the +4 VDC CMC Power Supply shall not be operated at less than +2.5 VDC or greater than 5.2 VDC (CG 1030). The +14 VDC CMC Power Supply shall not be operated at less than +8.5 VDC or greater than +17.0 VDC (CG 1020). The DSKY alpha numerics and status lamps shall be turned to the absolute minimum brightness for this test.

Note: The flashing indication of the CMC Power Supplies on CRT may be disregarded for this test. Rotate the LEB LTS NUMERICS SEL to approximately center position. Decrease to absolute minimum discernible lighting, corresponding to various power supply voltages.

6.2.19.3 Units R-154, insert 0001. Verify and execute.

6.2.19.4 Insert in C-156, -040001244 and execute. Verify on CRT that GV0116 is between -3.0 and -5.0 vdc.

6.2.19.5 Insert in C-156 -050001234 and execute. Verify on CRT that GV0106 is between -4.0 and -6.0 vdc.

6.2.19.6 Units R-154, insert 0111. Verify and execute.

6.2.19.7 Observe CG 1020, +14 VDC Power Supply, and CG 1030, +4 VDC Power Supply on CRT. Repeat 6.2.19.3 through 6.2.19.6 adjusting each C Start entry until CG 1020 is 12.1, +0.1, -0.0 vdc and CG 1030 is 3.40, +0.03, -0.00 vdc.

6.2.19.8 Initiate CMC Self Check by inserting the following in K-148.

- a. ERROR RESET
- b. VERB 21, NOUN 27, ENTER
- c. 77777, ENTER

Wait 200 seconds.

6.2.19.9 Insure that the DSKY RESTART lamp does not light, and that

- a. VERB 05 NOUN 31
- b. R1 = 01102

does not appear on DSKY.

6.2.19.10 Set INHIBIT VOLTAGE FAIL switch to OFF on PSAAM.

Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. If RESTART lamp does not light, repeat 6.2.19.3. Verify CMC Warning master alarms are lighted.

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- 6.2.19.11 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- ERROR RESET
 - VERB 21, NOUN 27, ENTER
 - 77777, ENTER
- 6.2.19.12 Units R-154, insert 0001. Verify and execute.
- 6.2.19.13 Insert in C-156 +108001244 and execute. Verify on CRT that GV0116 is between +0.8 and +11.8 vdc.
- 6.2.19.14 Units R-154, insert 0111. Verify and execute.
- 6.2.19.15 Observe CG 1020, +14 VDC Power Supply on CRT. Repeat 6.2.19.12 through 6.2.19.14 adjusting the C Start entry until CG 1020 is 16.4, +0.0, -0.1 vdc.
- 6.2.19.16 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- VERB 05, NOUN 31
 - R1 = 01102
- does not appear on DSKY.
- 6.2.19.17 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted. ~~at the end of 6.2.19.17 measuring CG 1020 and CG 1030 at PSAAM interface instead of CRT~~
- 6.2.19.18 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- ERROR RESET
 - VERB 21, NOUN 27, ENTER
 - 77777, ENTER
- 6.2.19.19 Units R-154, insert 0001. Verify and execute.
- 6.2.19.20 Insert in C-156, +092001234 and execute. Verify on CRT that GV0106 is between +8.2 and +10.2 vdc.
- 6.2.19.21 Units R-154, insert 0111. Verify and execute.
- 6.2.19.22 Observe CG 1030, +4 VDC Power Supply on CRT. Repeat 6.2.19.19 through 6.2.19.21 adjusting the C Start entry until CG 1030 is 4.60, +0.00, -0.03 vdc.
- 6.2.19.23 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- VERB 05, NOUN 31
 - R1=01102
- does not appear on DSKY.

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- 6.2.19.24 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted. ~~Verify that CG 1020 is at PSAAM interface instead of CRT.~~
- 6.2.19.25 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- ERROR RESET
 - VERB 21, NOUN 27, ENTER
 - 77777, ENTER.
- 6.2.19.26 Units R-154, insert 0001. Verify and execute.
- 6.2.19.27 Insert in C-156, -040001244 and execute. Verify on CRT that GV0116 is between -3.0 and -5.0 vdc.
- 6.2.19.28 Units R-154, insert 0111. Verify and execute.
- 6.2.19.29 Observe CG 1020, +14 VDC Power Supply on CRT. Repeat 6.2.19.26 through 6.2.19.28 adjusting the C Start entry until CG 1020 is 12.1, +0.1, -0.0 vdc.
- 6.2.19.30 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- VERB 05, NOUN 31
 - R1 = 01102
- does not appear on DSKY.
- 6.2.19.31 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted. ~~Verify that CG 1020 is at PSAAM interface instead of CRT.~~
- 6.2.19.32 Units R-154, insert 0000. Verify and execute.
- 6.2.19.33 Terminate CMC Self-Check by inserting into K-148:
- ERROR RESET
 - VERB 21, NOUN 27, ENTER
 - 00000, ENTER
- 6.2.19.34 Ensure that CG 1020, +14 VDC Power Supply indication is +14.0, ± 0.4 , and that CG 1030, +4 VDC Power Supply indication is +4.00 ± 0.20 VDC on CRT.

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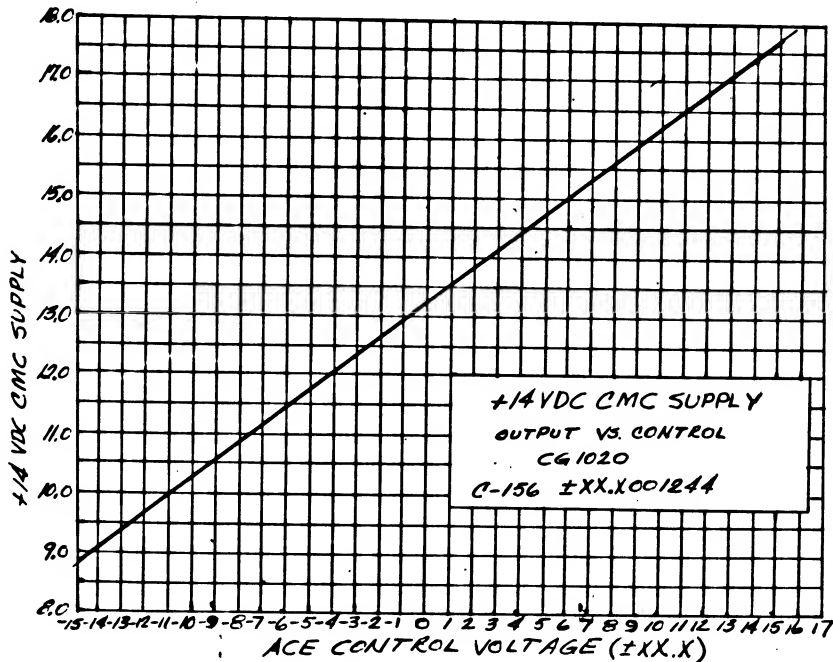
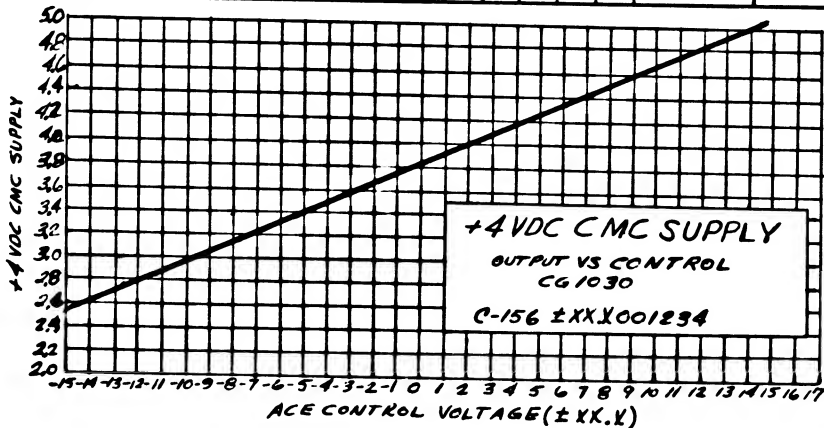


TABLE I

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6.2.21 Spacecraft Control and Displays Test

6.2.21.1 Perform Master Initialization before proceeding. (If not an operation)

6.2.21.2 FDAI Attitude Error

6.2.21.2.1 Insert in K148

- a. V 57 ENTER
- b. 00013 ENTER

6.2.21.2.2 Observe on CRT

- a. V 06 NOL Flashing
- b. PROG 07
- c. NO ATT ON
- d. R1, R2, and R3 Approx. 00000

6.2.21.2.3 Insert in K148

- a. VERB 33, ENTER

6.2.21.2.4 Observe on CRT

- a. V 06 NOL Flashing
- b. R1 +00385
- c. R2 -00385
- d. R3 +00385
- e. NO ATT OFF

6.2.21.2.5 Record CRT indications

- a. CG 2279 ROLL ATT ERROR - CDU DAC OUT +5.06±0.50 VRMS
- b. CG 2219 PITCH ATT ERROR - CDU DAC OUT -5.06±0.50 VRMS
- c. CG 2249 YAW ATT ERROR - CDU DAC OUT +5.06±0.50 VRMS

6.2.21.2.6 Insert in K148

- a. VERB 33, ENTER

6.2.21.2.7 Observe on CRT

- a. V 06 NOL Flashing
- b. R1 +00384
- c. R2 -00384
- d. R3 +00384

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6.2.21.2.8 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	+5.06±0.50VRMS	pos
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	-5.06±0.50VRMS	neg
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	+5.06±0.50VRMS	pos

6.2.21.2.9 Insert in K148

a. VERB 33, ENTER

6.2.21.2.10 Observe on CRT

a. V 06	N01	Flashing
b. R1		+00160
c. R2		-00160
d. R3		+00160

6.2.21.2.11 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	+2.11±0.21 VRMS	pos
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+4.11±0.21 VRMS	pos
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	+2.11±0.21 VRMS	pos

6.2.21.2.12 Insert in K148

a. VERB 33, ENTER

6.2.21.2.13 Observe on CRT

a. V 06	N01	Flashing
b. R1		+00135
c. R2		-00135
d. R3		+00135

6.2.21.2.14 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	+1.78±0.18 VRMS	pos
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+1.78±0.18 VRMS	pos
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	+1.78±0.18 VRMS	pos

6.2.21.2.15 Insert in K148

a. VERB 33, ENTER

6.2.21.2.16 Observe on CRT

a. V 06	N01	Flashing
b. R1		+00090
c. R2		-00090
d. R3		+00090

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6.2.21.2.17 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	+1.19±0.12 VRMS _{cs}
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	-1.19±0.12 VRMS _{cs}
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	+1.19±0.12 VRMS _{cs}

6.2.21.2.18 Insert in K148

a. VERB 33, ENTER

6.2.21.2.19 Observe on CRT

a. V 06	NO1	Flashing
b. R1		+00000
c. R2		+00000
d. R3		-00090

6.2.21.2.20 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	0.00±0.08 VRMS _{cs}
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	0.00±0.08 VRMS _{cs}
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-1.19±0.12 VRMS _{cs}

6.2.21.2.21 Insert in K148

a. VERB 33, ENTER

6.2.21.2.22 Observe on CRT

a. V 06	NO1	Flashing
b. R1		-00090
c. R2		+00090
d. R3		-00135

6.2.21.2.23 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-1.19±0.12 VRMS _{cs}
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+1.19±0.12 VRMS _{cs}
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-1.78±0.18 VRMS _{cs}

6.2.21.2.24 Insert in K148

a. VERB 33, ENTER

6.2.21.2.25 Observe on CRT

a. V 06	NO1	Flashing
b. R1		-00135
c. R2		+00135
d. R3		-00160

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6.2.21.2.26 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-1.78±0.18 VRMS
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+1.78±0.18 VRMS
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-2.11±0.21 VRMS

6.2.21.2.27 Insert in K148

a. VERB 33, ENTER

6.2.21.2.28 Observe on CRT

a. V 06	N01	Flashing
b. R1		-00160
c. R2		+00160
d. R3		-00384

6.2.21.2.29 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-2.11±0.21 VRMS
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+2.11±0.21 VRMS
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-5.06±0.50 VRMS

6.2.21.2.30 Insert in K148

a. VERB 33, ENTER

6.2.21.2.31 Observe on CRT

a. V 06	N01	Flashing
b. R1		-00384
c. R2		+00384
d. R3		-00385

6.2.21.2.32 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-5.06±0.50 VRMS
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+5.06±0.50 VRMS
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-5.06±0.50 VRMS

6.2.21.2.33 Insert in K148

a. VERB 33, ENTER

6.2.21.2.34 Observe on CRT

a. V 06	N01	Flashing
b. R1		-00385
c. R2		+00385
d. R3		+00000

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6.2.21.2.35 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-5.06±0.50 VRMS rms
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+5.06±0.50 VRMS rms
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	0.06±0.06 VRMS rms

6.2.21.2.36 Insert in K148

a. V 21	N01	ENTER
b. 02545		ENTER
c. 03302		ENTER
d. V 33		ENTER

6.2.21.2.37 Observe on CRT

a. V 96	N03	Flashing
b. NO ATT		ON
c. R1		+00000 approximately
d. R2		+00000 approximately
e. R3		+00000 approximately

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6.2.21.3 TVC Test

6.2.21.3.1 The G/N Autopilot Control and SPS Ready discretes shall be applied to the G/N interface.

6.2.21.3.2 Set the OPTICS MODE selector on the Indicator Control panel to MAN.

6.2.21.3.3 Insert in K148

a. VERB 33, ENTER

6.2.21.3.4 Observe on CRT

a. V 01	N 10	Flashing
b. R1		X7373
c. R3		00030

6.2.21.3.5 Insert in K148

a. V 33 ENTER

6.2.21.3.6 Observe on CRT

a. V 01	NOUN 10	Flashing
b. R1		37777
c. R3		00031

6.2.21.3.7 Insert in K148

a. V 33 ENTER

6.2.21.3.8 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00385
c. R2		-00385
d. R3		+00003

6.2.2.3.9 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+16.00+10.12±1.00 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	-16.00-10.12±1.00 VRMS

6.2.21.3.10 Insert in K148

a. VERB 33, ENTER

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6.2.21.3.11 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00384
c. R2		-00384
d. R3		+00003
e. NO ATT		OFF

6.2.21.3.12 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+10.12±1.00 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	-10.12±1.00 VRMS

6.2.21.3.13 Insert in K148

a. VERB 33, ENTER

6.2.21.3.14 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00160
c. R2		-00160
d. R3		+00003

6.2.21.3.15 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+4.23±0.42 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	-4.23±0.42 VRMS

6.2.21.3.16 Insert in K148

a. VERB 33, ENTER

6.2.21.3.17 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00135
c. R2		-00135
d. R3		+00003

6.2.21.3.18 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+3.56±0.36 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	-3.56±0.36 VRMS

6.2.21.3.19 Insert in K148

a. VERB 33, ENTER

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6.2.21.3.20 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00090
c. R2		-00090
d. R3		+00003

6.2.21.3.21 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-2.38 ± 0.24 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	-2.38 ± 0.24 VRMS

6.2.21.3.22 Set the OPTICS CONTROLLER SPEED Switch on the Indicator Control panel to HI.

6.2.21.3.23 Insert in K148

a. VERB 33, ENTER

6.2.21.3.24 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00000
c. R2		+00000
d. R3		+00003

6.2.21.3.25 While holding the Optics Hand Controller up and left (45°) no longer than 10 seconds, record CRT indications.

a. CG 3722	TRUNNION CDU DAC OUTPUT	0.00 ± 0.12 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	0.00 ± 0.12 VRMS

6.2.21.3.26 Insert in K148

a. VERB 33, ENTER

6.2.21.3.27 Observe on CRT

a. V 06	N 03	Flashing
b. R1		-00090
c. R2		+00090
d. R3		+00003

6.2.21.3.28 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-2.38 ± 0.24 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	$+2.38 \pm 0.24$ VRMS

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6.2.21.3.29 Set the OPTICS MODE Switch on the Indicator Control panel to ZERO for 30 seconds, then return to MAN.

6.2.21.3.30 Insert in K148

a. VERB 33, ENTER

6.2.21.3.31 Observe on CRT

a. V 06	N 03	Flashing
b. R1		-00135
c. R2		+00135
d. R3		+00003

6.2.21.3.32 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-3.56±0.36 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	+5.56±0.36 VRMS

6.2.21.3.33 Insert in K148

a. VERB 33, ENTER

6.2.21.3.34 Observe on CRT

a. V 06	N 03	Flashing
b. R1		-00160
c. R2		+00160
d. R3		+00003

6.2.21.3.35 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-4.22±0.42 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	+4.22±0.42 VRMS

6.2.21.3.36 Insert in K148

a. VERB 33, ENTER

6.2.21.3.37 Observe on CRT

a. V 06	N 03	Flashing
b. R1		-00384
c. R2		+00384
d. R3		+00003

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6.2.21.3.38 Record CRT indications

- a. CG 3722 TRUNNION CDU DAC OUTPUT -10.12±1.00 VRMS
- b. CG 3721 SHAFT CDU DAC OUTPUT +10.12±1.00 VRMS

6.2.21.3.39 Insert in K148

- a. VERB 33, ENTER

6.2.21.3.40 Observe on CRT

- a. V 06 N 03 Flashing
- b. R1 -00385
- c. R2 +00385
- d. R3 +00003

6.2.21.3.41 Record CRT indications

- a. CG 3722 TRUNNION CDU DAC OUTPUT -10.12±1.00 VRMS
- b. CG 3721 SHAFT CDU DAC OUTPUT +10.12±1.00 VRMS

6.2.21.3.42 Insert in K148

- a. V 34 ENTER
- b. V 40 N 20 ENTER
- c. V 41 N 20 ENTER
- d. +00000 ENTER
- e. +00000 ENTER
- f. +00000 ENTER

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APPENDIX I

Signal	Link	Nomenclature	G&N Test Requirement	PSAAM and/or SCA Uncertainty % of Full Scale
CG 1020	1	+14 VDC CMC SUPPLY	+14.0 ± 0.4 VDC	0%
CG 1030	1	+4 VDC CMC SUPPLY	+4.00 ± 0.2 VDC	0%
CG 1040	2	+120 VDC PIPA SUPPLY	+120 ± 6.0 VDC	1%
CG 1051	1	+20 VDC PIPA SUPPLY	+20.0 ± 1.2 VDC	0%
CG 1052	1	-20 VDC PIPA SUPPLY	-20 ± 2 VDC	0%
CG 1070	1	+4 VDC CDU SUPPLY	+4.0 ± 0.2 VDC	0%
CG 1100	1	-28 VDC SUPPLY	-27.5 ± 6.0 VDC	0%
CG 1110	2	2.5 VDC TM BIAS	+2.50±0.05 VDC	0%
CG 1201	2	IMU 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	1%
CG 1202	1	IMU 28V .8 KC 5% - 90° RMS	28.0 ± 1.4 VRMS	1.5%
CG 1203	1	IMU 28V .8KC 0° RMS	28.0 ± 2.1 VRMS	1.5%
CG 1207	1	PH DIFF IMU 5% 0°, -90°	90 ± 10°	3%
CG 1211	1	OPTX 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	1.5%
CG 1212	1	OPTX 28V .8KC 5% -90° RMS	28.00 ± 1.48 VRMS	1.5%
CG 1220	1	PH DIFF OPTX 1% IMU 1%	0° ± 10°	3%
CG 1331	2	3.2 KC 28V SUPPLY	28.6 ± 0.56 VRMS	1%
CG 1336	1	PH DIFF 3.2 KC 28V/CMC SYNC	0° ± 10°	3%
CG 1500	1	+28 VDC IMU OPERATE BUS	28.8 ± 3VDC	0%
CG 1510	1	+28 VDC IMU STANDBY BUS	28.8 ± 3 VDC	0%
CG 1520	1	+28 VDC CMC OPERATE BUS	28.8 ± 3 VDC	0%
CG 1530	1	+28 VDC OPTX OPERATE BUS	28.8 ± 3 VDC	0%
CG 2001	2	X PIPA SG O/P	5 VRMS max	3%
CG 2021	2	Y PIPA SG O/P	5 VRMS max	3%
CG 2041	2	Z PIPA SG O/P	5 VRMS max	3%
CG 2108	1	IG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2112	2	IG LX RESOLVER O/P SIN	(18.38 ± 1.84)	2.5%
CG 2113	2	IG LX RESOLVER O/P COS	19.65 ± 0.98VRMS @ 45°	2.5%
CG 2117	2	IG SERVO ERROR IN PHASE	0.0 ± 60mv RMS @ null	2%
CG 2120	1	IG TORQUE MOTOR CURRENT	0.125 amp max during Fine Alignment Torquing	0%
CG 2138	1	MG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2142	2	MG LX RESOLVER O/P SIN	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2143	2	MG LX RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2147	2	MG SERVO ERROR IN PHASE	0.0 ± 60 mv rms @ null	2%
CG 2150	1	MG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	0%
CG 2168	1	OG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2172	2	OG LX RESOLVER O/P SIN	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2173	2	OG LX RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2177	2	OG SERVO ERROR IN PHASE	0.0 ± 60mvRMS @ null	2%
CG 2180	1	OG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	0%
CG1042	1	+120 VDC PIPA SUP NOISE RMS	1.5 VRMS MAX	0%
CG1053	1	+20 VDC PIPA SUP NOISE RMS	1.0 VRMS MAX	0%
CG1071	1	+4 VDC CMC SUP NOISE RMS	1.0 VRMS MAX	0%
CG1501	1	+28V IMU OPERATE BUS NOISE RMS	1.0 VRMS MAX	0%
CG1511	1	+28V IMU STANDBY BUS NOISE RMS	1.0 VRMS MAX	0%
CG1521	1	+28V CMC OPERATE BUS NOISE RMS	2.0 VRMS MAX	0%
CG1531	1	+28V OPTX OPERATE BUS NOISE RMS	2.0 VRMS MAX	0%

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<u>Signal</u>	<u>Link</u>	<u>Nomenclature</u>	<u>G&N Test Requirement</u>	<u>PSAAM and/or SCA Uncertainty % of Full Scale</u>
CG 2219	1	PITCH ATT ERROR - CDU DAC O/P	5.06 ± 0.5 VRMS @ 17°	2%
CG 2220	1	IG CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 2221	1	IG CDU COARSE ERROR	0.0 ± 0.68 VRMS @null	1%
CG 2249	1	YAW ATT ERROR-CDU DAC O/P	5.06 ± 0.5VRMS @ 17°	2%
CG 2250	1	MG CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 2251	1	MG CDU COARSE ERROR	0.0 ± 0.68VRMS @ null	1%
CG 2279	1	ROLL ATT ERROR-CDU DAC O/P	5.06 ± 0.5VRMS @17°	2%
CG 2280	1	OG CDU FINE ERROR	0.0 ± 0.07 VRMS 2 null	1%
CG 2281	1	OG CDU COARSE ERROR	0.0 ± 0.68 VRMS	1%
CG 2300	1	PIPA TEMPERATURE	130 ± 1.5°F Operate Mode	2%
CG 3011	2	TRUNNION CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 3021	1	SHAFT CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 3117	1	SXT SHAFT SERVO ERROR IN PH	2 VRMS max	2%
CG 3118	1	SXT TRUNNION SERVO ERROR IN PHASE	2 VRMS max	2%
CG 3140	1	SXT SHAFT TACH O/P	3.1 ± 1.1VRMS @ Hi Rate	2%
CG 3145	1	SXT SHAFT MTR CONTROL WINDING	3.3 ± 1.3VRMS @ Hi Rate	2%
CG 3150	1	SXT TRUNNION TACH O/P	3.3 ± 1.3VRMS @ Hi Rate	2%
CG 3155	1	SXT TRUNNION MTR CONTROL WINDING	0.85 ± 0.35VRMS at Hi Rate	2%
CG 3160	1	SCT SHAFT TACH O/P	3.3 ± 1.3 VRMS @ Hi Rate	2%
CG 3170	1	SCT TRUNNION TACH O/P	0.85 ± 0.35VRMS @Hi Rate	2%
CG 3721	1	SHAFT CDU DAC O/P	10.12±1.00 VRMS @17°	1%
CG 3722	2	TRUNNION CDU DAC O/P	10.12±1.00 VRMS @ 17°	1%
CG 4300	2	CMC TEMP	87.5±42.5°F	0%
CG 6020	1	PIPA CAL MODULE TEMP	72.5±27.5°F	0%
CG 6021	1	IMU 800 cps 5% TEMP (PSA)	90±30°F	0%
CG 2301	1	IRIG TEMPERATURE	135 ± 2.5°F in Operate	2%

All uncertainties specified above and those due to instrumentation in the ACE equipment shall be root sum squared with the basic system tolerances to yield an acceptable tolerance for use when testing the G&N System in the spacecraft.

PSAAM OUTPUT is the source of Link 1 signals

SCA OUTPUT is the source of Link 2 signals.

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ADDENDUM I

SCOPE: The following changes are required to make ND1002325 applicable as G&N System technical support documentation for CSM 101.

Addition 1: Paragraph 6.2.7.2.7. Add the following:
During this 12 minute period monitor IG TORQUE MOTOR CURRENT (CG 2120) on the CRT. This measurement shall not exceed 0.125 amp.

Addition 2: Paragraph 6.2.7.3.5. Add the following:
During this 12 minute period monitor OG TORQUE MOTOR CURRENT (CG 2180) on the CRT. This measurement shall not exceed 0.125 amp.

Addition 3: Paragraph 6.2.7.4.5. Add the following:
During this 5 minute period monitor MG TORQUE MOTOR CURRENT (CG 2150) on the CRT. This measurement shall not exceed 0.125 amp.

Addition 4: Add paragraph 6.2.4.14 to read as follows: (at the end of 6.2.4.14 On the Event Recorder verify that the IMU HTR Current discrete (CG2302) and IMU Blower current discrete (CG 2303) are ON (may cycle OFF momentarily.))

Addition 5: Paragraph 6.2.13.6. Add the following step prior to 6.2.13.6:
During the Trunnion Slew Rate Test HI Speed (6.2.13.6) monitor and verify the following signals on the CRT.

Signal	Requirement
a. SXT TRUNNION TACH O/P (CG 3150)	3.3±1.3 VRMS
b. SCT TRUNNION TACH O/P (CG 3170)	-0.85±0.35 VRMS

Addition 6: Paragraph 6.2.13.9. Add the following step prior to 6.2.13.9:
During the Shaft Slew Rate Test - HI speed (6.2.13.9) monitor and verify the following signals on the CRT.

Signal	Requirement
a. SXT SHAFT TACH O/P (CG 3140)	3.3±1.3 VRMS
b. SCT SHAFT TACH O/P (CG 3160)	-3.3±1.3 VRMS

Addition 7: Paragraph 6.2.13.18. Add the following step prior to 6.2.13.18:
During the Trunnion Slew Rate Test LO Speed monitor and verify the following signal on the CRT.

Signal	Requirement
a. TRUNNION CDU FINE ERROR (CG 3011)	±.07 VRMS MAX.

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Addition 8: Paragraph 6.2.13.21. Add the following step prior to 6.2.13.21:
During the Shaft Slew Rate Test LO Speed Monitor and verify the following
signal on the CRT.

Signal	Requirement
a. SHAFT CDU FINE ERROR (CG 3021)	±.07 VRMS MAX

Addition 9: Paragraph 6.1.2.1. Add new paragraph 6.1.2.1.5 as follows:
Data from the on board tape recorder shall be made available and the
following signals verified.

- a. VIB NB ROLL (CG 6001)
- b. VIB NB PITCH (CG 6002)
- c. VIB NB YAW (CG 6003)

Addition 10: Paragraph 6.2.1.5.6, add to the first sentence the following:

"....PIPA TEMP (CG 2300) and IRIG TEMP (CG 2301) on the CRT."

Paragraph 6.2.3.1, add 6.2.3.1.13 as follows:

"30 minutes after the application of IMU OPERATE power record IRIG TEMP
(CG 2301) displayed on the CRT"

Paragraph 6.2.3.1.14, add to the first sentence the following:

"....PIPA TEMP (CG 2300) and IRIG TEMP (CG 2301 every...."

Paragraph 6.2.3.1.15 change to read as follows:

"When 2 hours have elapsed since the application of IMU OPERATE power
record PIPA TEMP and IRIG TEMP. PIPA TEMP shall be $130.5^{\circ} \pm 1.5^{\circ}\text{F}$.
IRIG TEMP shall be $135^{\circ} \pm 2.5^{\circ}\text{F}$. PIPA TEMP shall be within 0.5°F of that
recorded in 6.2.3.1.12 and 6.2.1.5.4. IRIG TEMP shall be within 0.5°F of
that recorded in 6.2.3.1.13".

Paragraph 6.2.5.2.16 Add the following to Table VI:

"14 CG 2301. IRIG TEMPERATURE"

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ADDENDUM II

Scope: The following changes are required to make ND1002325 applicable as G&N System technical support documentation for systems containing SUNDIAL C test ropes. Refer to Drawing 2014999 to define further which test ropes and jumper modules shall be installed.

- Change 1: Paragraphs 6.2.9.1.4, 6.2.9.2a, 6.2.9.3a, 6.2.9.8a, 6.2.9.6a, 6.2.9.7a, 6.2.9.8, 6.2.9.10a, 6.2.9.11a, 6.2.9.13a, 6.2.9.18a, 6.2.9.16a, 6.2.9.22. In each of these paragraphs change "VERB 06 NOUN XX flashing" to "VERB 33 NOUN XX flashing."
- Change 2: Paragraphs 6.2.21.2.2a, 6.2.21.2.4a, 6.2.21.2.7a, 6.2.21.2.10a, 6.2.21.2.13a, 6.2.21.2.16a, 6.2.21.2.19a, 6.2.21.2.22a, 6.2.21.2.25a, 6.2.21.2.28a, 6.2.21.2.31a, 6.2.21.2.34a, 6.2.21.2.37a, 6.2.21.3.8a, 6.2.21.3.11a, 6.2.21.3.14a, 6.2.21.3.17a, 6.2.21.3.20a, 6.2.21.3.24a, 6.2.21.3.27a, 6.2.21.3.31a, 6.2.21.3.34a, 6.2.21.3.37a, 6.2.21.3.40a, In each of these steps change "V06" to "V33".
- Change 3: Paragraph 6.2.16.7.19 Change FROM: On K-148 enter the following sequence:
- | | | |
|---------|---------|------|
| VERB 21 | NOUN 01 | ENTR |
| 00407 | | ENTR |
| 77757 | | ENTR |
| VERB 21 | NOUN 01 | ENTR |
| 00411 | | ENTR |
| 00020 | | ENTR |
| VERB 33 | | ENTR |
- Change TO: On K-148 enter the following sequence:
- | | | |
|---------|---------|------|
| VERB 21 | NOUN 01 | ENTR |
| 02502 | | ENTR |
| 77757 | | ENTR |
| VERB 21 | NOUN 01 | ENTR |
| 02504 | | ENTR |
| 00020 | | ENTR |
| VERB 33 | | ENTR |
- Change 4: Paragraph 6.2.16.7.33 Change FROM: On K-148 enter the following sequence:
- | | | |
|---------|---------|------|
| VERB 21 | NOUN 01 | ENTR |
| 00405 | | ENTR |
| 00020 | | ENTR |
| VERB 21 | NOUN 01 | ENTR |
| 00407 | | ENTR |
| 77757 | | ENTR |
| VERB 33 | | ENTR |

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ADDENDUM II

Change 4
(Continued)

Change TO: On K-148 enter the following sequence:

VERB 21	NOUN 01	ENTR
02500		ENTR
00020		ENTR
VERB 21	NOUN 01	ENTR
02502		ENTR
77757		ENTR
VERB 33		ENTR

APOLLO G&N Specification
ND 1002325 REV F

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POST INSTALLATION CHECKOUT PROCESS
SPECIFICATION FOR THE APOLLO GUIDANCE
AND NAVIGATION SYSTEM -- BLOCK II

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
11/1/66	A	31765	1-116 was 116 pages, now 118 pages.	EA	WLS
1/26/67	B	32784	2, 3, 6, 9, 11, 15, 16, 24, 27, 29, 34, 39	EA	---
			44-50, 54, 56-59, 61-65, 67, 68, 72-		
			74, 76-79, 81-103, 106-117;		
			was 118 pages, now 119 pages.		
2/7/67	C	32919	10-119, Was 119 pages now 124		
4/6/67	D	33539	8, 9, 10, 12, 15, 24, 35, 38, 40, 41,	EA	-
			43-46, 50-56, 58-78, 81, 83-87, 89,		
			95-124.		
6/22/67	E	34000	2, 6, 10, 11, 24-27, 29-124, Was 124 pages, now 131 pages.	EA	WS
9/22/67	F	34703	1, 6-131. Was 131 pages, Now 134 pages.	SB	---

This specification consists of page 1 to 134 including Appendix I pages 129-130. and Addendum I, pages 131 and 132 and Addendum II, pages 133 and 134.

APPROVALS	NOT REQUIRED PER CCA-497-0274 NASA/MSC				ACFD
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- 5.1.2.5 Failure of the G&N System to pass any examination or test specified herein shall tentatively classify the G&N System as nonconforming. The normal test sequence may be continued on determination of the cause of the nonconformance if not detrimental to the G&N System or other interfacing subsystems. This determination shall have the concurrence of the G&N contractor test team. All nonconformance shall be investigated and cleared by waiver (FNN), correction of test specification, or hardware replacement. The suspected malfunctioning hardware shall be removed and returned to the laboratory, where the malfunction shall be verified. Only after malfunction verification shall a flight certified replaceable unit be installed in the G&N System.
- 5.1.2.6 The G&N System shall be operating in STANDBY mode with G&N power applied for a minimum of two hours prior to torquing of inertial components. In the event STANDBY or G&N power is interrupted, an equivalent time period shall be allowed when power is restored before transfer to the OPERATE mode, except that when the interval of interruption exceeds two hours, a two-hour warmup period shall be mandatory. Exceptions to the above are noted in 6.2.5.2.
- 5.1.2.7 The interruption of +28 VDC power to the G&N System through the Main A and Main B power busses shall be cause for the Command Module G&N System operator to immediately initiate the Emergency shutdown procedure (6.1.4) to preclude damage to the G&N System.
- 5.1.2.8 The SCT and SXT eyepieces shall be stowed whenever the instruments are not in use to preclude damage to them. It shall be necessary to install the eyepieces when testing requires use of the instrument.
- 5.1.2.9 To preserve the operational life of the components of the MDC and LEB DSKY's, the monitor routines shall be used only when required by test procedure or troubleshooting. Such routines shall be terminated as quickly as possible in the test flow. Computer routines which cause the DSKY display to flash (either requesting data or displaying data) shall also be terminated as quickly as possible.
- 5.1.2.10 To reduce the possibility of the optics drifting into the stops the Optics Speed switch should be set to LO whenever the optics is to be ON and not used for any appreciable time.
- 5.1.2.11 Avoid repeated slewing of SXT shaft and trunnion into the mechanical stops.

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5.4 Test Sequence

- 5.4.1 The test sequence normally should follow the flow outlined by Figure 1 in the order specified except 6.2.5. Turn On and Turn Off procedure, which may be performed as the requirement arises.

TABLE I G&N TESTS

Paragraph No.

6.1.3	Prepower Application Tests (Part of G&N Installation OCP)
6.2.1	Application of Standby Power to G&N System
6.2.2	CMC Operational Test
6.2.3	Operate Power On Test
6.2.4	G&N Power Supplies Test
6.2.5	General Turn Off and Turn On Procedure
6.2.6	G&N Operational Test
6.2.7	Gimbal Friction Test
6.2.8	G&N Panel Brightness & Lamp Test
6.2.9	Semi-Automatic Mode Control Test
6.2.10	Zero Optics Test
6.2.11	Optics Coordinate Transformation Control Test
6.2.12	Optics Positional Accuracy Test
6.2.13	Optics Slew Rate Test
6.2.14	Stabilization Loop Step Response Test
6.2.16	IRIG Scale Factor Test
6.2.16	IMU Performance Test
6.2.17	Fine Alignment Test SXT-NB-IMU
6.2.18	Gyrocompassing Test
6.2.19	Voltage Margin Test
6.2.20	S/C Control & Display Test

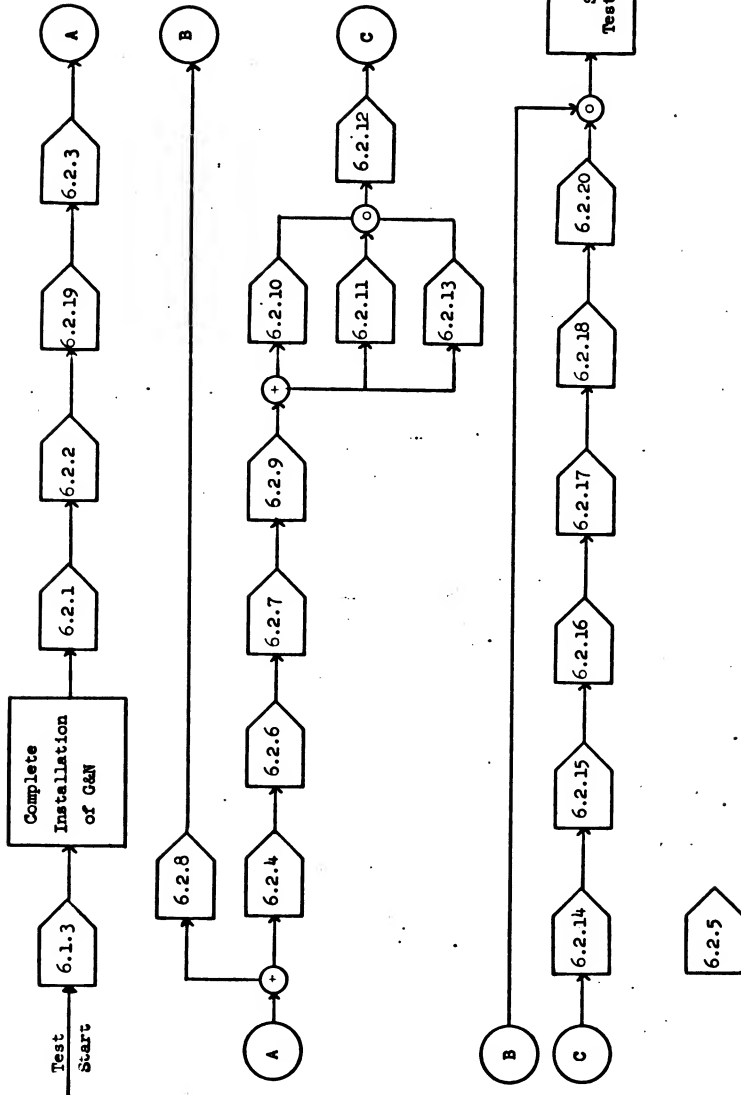


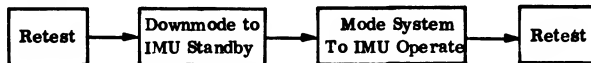
FIGURE 1 - G&N INDIVIDUAL SYSTEMS TEST SEQUENCE

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5.4.2 Failure of the D criteria for IRIG and PIPA parameters.

5.4.2.1 If D_1 , D_2 , or D_3 exceeds its maximum value as specified in Table D Paragraph 6.2.16.10.8 for any IRIG or PIPA, a retest sequence shall be initiated as indicated below:



RETEST SEQUENCE

The retest sequence shall be performed using the paragraphs indicated in Table I corresponding to the out-of-spec parameters. Table 2 indicates the test positions and other isolated parameters that must be recalculated and qualified.

If D_1 , D_2 , or D_3 exceeds its maximum value after the retest sequence is completed, the requirements of 5.4.2.2 (IRIG) or 5.4.2.3 (PIPA) shall apply. If D_1 , D_2 , and D_3 are within tolerances specified in Table D after the retest sequence is completed, the original out-of-tolerance D terms calculated in paragraph 6.2.16.10.8 shall be exonerated.

5.4.2.2 IRIG stability requirements

5.4.2.2.1 Failure to be within the maximum values for D_1 or D_2 or D_3 after the retest sequence shall constitute failure of the unit.

5.4.2.3 PIPA stability requirements

5.4.2.3.1 Failure to be within the maximum limits of D_1 or D_2 or D_3 after the retest sequence constitute failure of the unit.

5.5 Retest subsequent to replacement of a malfunctioned assembly with that of a flight certified assembly shall be at the discretion of NASA Engineering. Table II can be used as a guide to determine general retest requirements. In all retest procedures, the test sequence of Figure 1 shall be adhered to.

5.6 It is assumed that the Test Conductor has a working knowledge of the test equipment used; therefore, this procedure contains only the steps related directly to the G&N System components. If any questions arise concerning the test equipment, the Test Conductor should refer to the pertinent operational manuals.

5.7 The following requirements shall be completed before any of the tests in this specification are attempted.

5.7.1 The G&N System shall be Government Furnished Property.

5.7.2 The installation of the G&N System into the spacecraft shall have been completed as specified in Mechanical Installation Specification for Apollo Guidance Equipment Block II, MA0308-0107.

5.7.2.1 Interfacing systems (SCS, C & IS, EPS, ECS) shall have been verified to conform to loading and operational requirements as specified by the appropriate ICD.

5.7.3 All ACE equipment shall have been qualified in accordance with the respective quality assurance specifications prior to use with the G&N System.

[illegible]

**APOLLO G&N Specification
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1. INTRODUCTION

- Perform step and wait 20 sec. before proceeding.

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TABLE 2

O. O. S. PARAMETER	PERFORM POSITIONS	PARAMETERS TO BE REQUALIFIED
NBDY	1	NBDY
NBDZ	2	NBDZ
NBDX	3	NBDX
ADSRAY	1 and 4	ADSRAY, NBDY
ADSRAZ	2 and 9	ADSRAZ, NBDZ
ADSRAX	3 and 7	ADSRAX, NBDX
ADIA Y	1 thru 3, 7 and 10	NBDY, NBDX, ADIAX, ADSRAX, ADIA Y, NBDZ
ADIAZ	2 thru 4	NBDZ, NBDX, ADIAZ
ADIAX	1 thru 3	NBDX, NBDZ, ADIAX, NBDY
X PIPA Bias or S. F.	1 thru 2	X PIPA BIAS, NBDY, NBDZ, X PIPA S. F.
Y PIPA Bias or S. F.	5 and 6	Y PIPA BIAS Y PIPA S. F.
Z PIPA Bias or S. F.	3 and 4	Z PIPA Bias NBDX Z PIPA S. F.

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Paragraph Number	Test Title	IMU	NAV BASE	OPTICS	CMC	PSA	TEB DSKY	MDC DSKY	SIGN COND	GDU	G&N HARNESS	PIPA ELECT.	INDICATOR CONTROL PANEL
6.1.3	Pre-Power Application Tests	X	X	X	X	X	X	X	X	X	X	X	X
6.2.1	Application of Standby Power to G&N System	X	X		X	X	X	X	X	X	X	X	
6.2.5	General Turn OFF and Turn ON Procedure	*	*	*	*	*	*	*	*	*	*	*	*
6.2.3	Operate Power On Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.2	CMC Operational Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.8	G&N Panel Brightness and Lamp Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.6	G&N Operational Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.10	Zero Optics Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.13	Optics Slow Rate Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.11	Optics Coordinate Transformation Control	X	X	X	X	X	X	X	X	X	X	X	X
6.2.12	Optics Positional Accuracy Test		X	X	X	X	X	X	X	X	X	X	X
6.2.9	Semi-Automatic Mode Control Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.14	Skab Loop Step Response Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.15	IRIG Scale Factor Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.16	IMU Performance Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.17	Fine Alignment Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.19	Voltage Margin Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.7	Gimbal Friction Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.18	Gyrocompassing Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.4	G&N Power Supplies Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.21	Spacecraft Control and Displays Test	X	X	X	X	X	X	X	X	X	X	X	X

* To be used as necessary to turn system on and off.

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- 5.10 The test equipment listed in paragraph 4.1 shall be connected and ready for operation before the tests of this specification are initiated.
- 5.11 Data Records
- 5.11.1 All data concerning the checkout and operation of the G&N System as monitored via ACE, shall be recorded on the data sheets associated with their corresponding test. Out of tolerance readings shall be recorded and flagged by appropriate symbols.
- 5.11.1.1 All test data obtained while demonstrating the requirements of this document shall be permanently recorded and forwarded with the tested G&N to the next receiving agency.
- 5.11.1.2 A record of the amount of time each of the four prime power busses are on shall be kept and forwarded with the G&N to the next receiving agency.
- 5.12 Interface
- 5.12.1 The APOLLO G&N System shall interface with accepted ECS and EPS distribution systems for power and environment control purposes and with the SCS or SCS substitute system for signal interface in accordance with the applicable ICD's.

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6.0 DETAIL REQUIREMENTS

6.1 Initial Test Conditions

6.1.1 The following precautions shall be observed to preclude loss of continuity in inertial component performance history of the IMU. Deviation may necessitate recalibration of the inertial components.

6.1.1.1 The IMU shall be supplied with heater power on a continuous basis. When S/C Ground Power Supply, Model No. C14-418 is not providing heater power, then heater power shall be supplied through the Inertial Components Temperature Controller (ICTC) Model No. 513-100. The temperature of the IRI's shall be maintained between 120° and 150°F. The temperature of the PIPA's shall be maintained between 115° and 145°F.

6.1.1.2 The Standby Mode is identified by the circuit breakers IMU HTR MN A, IMU HTR MN B, COMPUTER MN A and MN B in the ON position and IMU MN A and MN B and the G&N Power-IMU switch on LEB Lighting Control Panel in the OFF position. The Operate Mode is identified by the circuit breaker IMU HTR MN A, MN B, COMPUTER MN A and MN B in the ON position and IMU MN A and MN B and the G&N Power-IMU switch on the LEB Lighting Control Panel in the ON position. The G&N System shall be operating in the Standby Mode with CMC power ON for a minimum of two hours prior to advancing to the IMU Operate Mode. In the event Standby or CMC power is interrupted, an equivalent time period, but not less than 15 minutes, shall be allowed when power is restored before advancing to the Operate Mode, except that when the interval of interruption exceeds two hours, a two-hour warmup period shall be mandatory (exceptions to the 2-hour warmup are noted in 6.2.5.2).).

6.1.1.3 The Inertial Measurement Unit shall not be without heater power for more than 15 minutes.

6.1.1.4 During the turn on of the G&N power, COMPUTER MN A and MN B and IMU HTR MN A and IMU HTR MN B circuit breakers must be turned on before the IMU MN A and IMU MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. During the turn off of the G&N power the IMU MN A and IMU MN B circuit breakers must be turned off before the IMU HTR MN A and IMU HTR MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. In no case shall COMPUTER MN A and MN B circuit breaker be turned off before IMU MN A and MN B circuit breakers.

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- 6.1.1.5 A warmup period of 1 hour with OPERATE power applied shall be required prior to performing any test in which gyro and accelerometer parameters are measured, and 15 minutes warmup prior to any test in which precision amplitude and frequency power supply checks are made.
- 6.1.1.6 The following Command Module switches shall be in the position shown unless specifically directed otherwise in a procedural function.
- UP TIM switches on the LEB G&N Control Panel and MDC Panel 2 shall be set to ACCEPT.
 - LAUNCH VEHICLE - GUIDANCE switch on MDC Panel 2 shall be set to IU.
 - The SC CONT switch on MDC Panel 1 shall be set to CMC.
 - The CMC MODE switch on MDC Panel 1 shall be set to AUTO.
 - The Δ V CG switch on MDC Panel 1 shall be set to CSM.
 - The TRACKER switch on G&N Indicator Control Panel shall be set to OFF.
 - The LIGHTS-INTEGRAL control on the LEB Lighting Control Panel and the Left Hand Circuit Breaker panel shall be set to the minimum brightness - OFF position.
- 6.1.2 The following optical reference alignment requirements shall be demonstrated.
- 6.1.2.1 G&N Installation Qualification Fixture
- 6.1.2.1.1 The SXT Optical Reference No. 1 (Azimuth Autoset) LOS shall be located approximately 40 degrees (CW when viewed from above) from the SCZ axis measured in a horizontal plane. At this position, the Optical Reference shall be capable of being viewed through the SXT ST LOS.
- 6.1.2.1.2 The SXT Optical Reference LOS position with respect to the horizontal plane shall be known to within 5 arc-seconds. The azimuth bearing of the Optical Reference LOS shall be known to within ± 30 minutes of arc.
- 6.1.2.1.3 The SXT Optical Reference No. 2 LOS shall be located approximately 80 degrees from the SXT Optical Reference No. 1 (40 degrees from S/C Z axis) measured in a horizontal plane. At this position, the Optical Reference shall be capable of being viewed through the SXT SEAR LOS.

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- 6.1.2.1.3.1 The SXT optical reference LOS position with respect to the horizontal plane shall be known to within 5 arc-seconds.
- 6.1.2.1.4 SXT Optical Reference No. 3 shall be capable of being viewed through the SXT LLOS and the STAR LOS simultaneously at the Zero Optics position.
- 6.1.2.1.4.1 SXT Optical Reference No. 3 shall have the capability to measure the nonparallelism of the LLOS and STAR LOS to a resolution of 2 arc-seconds.

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6.1.3 Prepower Application Requirements

6.1.3.1 Prior to connecting G&N power connectors 56P30 and 56P31 to spacecraft power connectors CO3WLJ345 and CO3WLJ346, respectively, it is necessary to perform a complete verification of spacecraft power. Verification shall be performed with the installation of the G&N System complete except for connection of 56P30 and 56P31 to the S/C connectors.

6.1.3.2 Resistance Check on S/C Power Connectors.

6.1.3.2.1 Insure that the following switches and circuit breakers are set to the position indicated.

- a. GUIDANCE/NAVIGATION POWER AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- b. GUIDANCE/NAVIGATION IMU MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- c. GUIDANCE/NAVIGATION IMU HTR MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- d. GUIDANCE/NAVIGATION COMPUTER MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- e. GUIDANCE/NAVIGATION OPTICS MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- f. G/N POWER switch on the Right Hand Circuit Breaker Panel to OFF.
- g. G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.
- h. G/N POWER - IMU switch on the LEB Lighting Control Panel to OFF.

6.1.3.2.2 Obtain GSE tool consisting of connectors, extension cables, and connector terminal test box. Mate connectors P1 and P2 of the extension cables with S/C power connectors CO3WLJ345 and CO3WLJ346 respectively. Using a VTVM measure the resistance between the terminals listed in Table I. Resistance measurements shall be as specified in Table I.

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TABLE I. RESISTANCE REQUIREMENTS FOR S/C POWER CONNECTORS

Test No.	From	To	Requirements
1	P1-2	P2-1	Open
2	P1-5		
3	P1-6		
4	P1-7		
5	P1-8		
6	P1-9		
7	P1-10		
8	P1-11		
9	P1-12		
10	P1-13		
11	P1-14		
12	P1-17		
13	P2-2		
14	P2-5		
15	P2-6		
16	P2-7		
17	P2-8		
18	P2-9		
19	P2-10		
20	P2-11		
21	P2-12		
22	P2-13		
23	P2-14		
24	P2-17		
25	P1-1	P1-18	Continuity
26	P1-3		
27	P1-4		
28	P1-15		
29	P1-16		
30	P2-1		
31	P2-3		
32	P2-4		
33	P2-15		
34	P2-16		

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6.1.3.3 Polarity and Voltage Check on S/C Power

6.1.3.3.1 Perform a voltage and polarity check of the G&N S/C power by performing the measurements indicated in Table II. Set the following switches to the position indicated.

- G/N POWER-OPTICS switch on the LEB Lighting Control Panel to ON.
- G/N POWER - IMU switch on the LEB Lighting Control Panel to ON.
- G/N POWER switch on the Right Hand Circuit Breaker Panel to AC1.

For each measurement in Table II set the indicated circuit breaker on the Right Hand Circuit Breaker Panel to ON (breaker pushed in). After each measurement return the circuit breaker to OFF (breaker pulled out).

TABLE II. POLARITY & VOLTAGE REQUIREMENTS
FOR S/C POWER.

Test No.	Circuit Breaker	Polarity & Connector		Requirements
		Pin No.		
		Low	High	
1	COMPUTER MN A	P1-1	P1-2	+28.8 + 3VDC
2	OPTICS MN A	P1-14	P1-7	+28.8 + 3VDC
3	IMU MN A	P1-15	P1-9	+28.8 + 3VDC
		P1-16	P1-10	+28.8 + 3VDC
4	IMU HTR MN A	P1-3	P1-8	+28.8 + 3VDC
5	COMPUTER MN B	P2-1	P2-2	+28.8 + 3VDC
6	OPTICS MN B	P2-14	P2-7	+28.8 + 3VDC
7	IMU MN B	P2-15	P2-9	+28.8 + 3VDC
		P2-16	P2-10	+28.8 + 3VDC
8	IMU HTR MN B	P2-3	P2-8	+28.8 + 3VDC
9	POWER AC 1	P1-18	P1-17	115 + 10 VAC 400 + 7 cps
Set G/N POWER switch on the Right Hand Circuit Breaker Panel to AC 2.				
10	POWER AC 2	P1-18	P1-17	115 + 10VAC 400 + 7 cps

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- 6.1.3.3.2 Verify all circuit breakers exercised in Table II are in the OFF position (breakers pulled out). Set the following switches to the OFF position.
- a. G/N POWER - OPTICS switch on the LEB Lighting Control Panel.
 - b. G/N POWER - IMU switch on the LEB Lighting Control Panel.
 - c. G/N POWER switch on the Right Hand Circuit Breaker Panel.
- 6.1.3.3.3 Disconnect connectors P1 and P2 of the test cables from S/C connectors CO3WLJ345 and CO3WLJ346, respectively.
- 6.1.3.4 Resistance Check on G&N Power Connectors
- 6.1.3.4.1 Connect test cable connectors J1 and J2 to G&N connectors 56P30 and 56P31, respectively. Using a VIVOM, measure the resistance between the terminals listed in Table III. The measurements shall meet the requirements listed in Table III.

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TABLE III. RESISTANCE REQUIREMENTS FOR G&N
POWER CONNECTORS

Test No.	From	To	Requirements (ohms)	Results
1	J1-15	J1-6	1000 to infinity	
2	J1-15	J1-14	1000 to infinity	
3	J1-15	J1-1	1000 to infinity	
4	J1-15	J1-18	5 meg to infinity	
5	J1-15	J1-16	0.0 to 0.5	
6	J1-15	J1-3	0.0 to 0.5	
7	J1-15	J2-15	0.0 to 0.5	
8	J1-14	J2-14	0.0 to 0.5	
9	J1-1	J2-1	0.0 to 0.5	
10	J1-6	J2-6	0.0 to 0.5	
11	J1-16	J2-16	0.0 to 0.5	
12	J1-3	J2-3	0.0 to 0.5	
13	J1-14	J1-6	1000 to infinity	
14	J1-1	J1-14	1000 to infinity	
15	J1-1	J1-6	0.0 to 2.0 infinity	
16	J1-18	J1-6	5 meg to infinity	
17	J1-18	J1-14	5 meg to infinity	
18	J1-18	J1-1	5 meg to infinity	
19	J1-2	J1-1	2.8 to infinity	
20	J1-9	J1-15	1.1 to infinity	
21	J1-10	J1-16	1.1 to infinity	
22	J1-7	J1-14	2.8 to infinity	
23	J1-8	J1-3	3.7 to infinity	
24	J1-17	J1-18	5 to 20	
25	J2-2	J2-1	2.8 to infinity	
26	J2-9	J2-15	1.1 to infinity	
27	J2-10	J2-16	1.1 to infinity	
28	J2-7	J2-14	2.8 to infinity	
29	J2-8	J2-3	3.7 to infinity	

6.1.3.5 Disconnect the test cable connectors J1 and J2 from G&N power connectors 56P30 and 56P31, respectively. Mate G&N connector 56P30 to S/C connector C03WLJ345 and mate G&N connector 56P31 to S/C connector C03WLJ346. Mate G&N connector 56P32 to S/C connector C03WLJ347.

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6.1.4 Emergency Shutdown Procedure

CAUTION: In the event of a malfunction occurrence which could damage the G&N System before the normal shutdown procedure 6.2.5 could be performed, the following sequence should be utilized in the spacecraft.

6.1.4.1 On the LEB Lighting Control Panel set the G/N POWER-IMU and G/N POWER - OPTICS switches to OFF.

6.1.4.2 On the Right Hand Circuit Breaker Panel set the following switches and circuit breakers to OFF (breakers pulled out).

- a. GUIDANCE/NAVIGATION COMPUTER MN A and MN B
- b. GUIDANCE/NAVIGATION IMU HTR MN A and MN B
- c. G/N POWER switch to OFF
- d. GUIDANCE/NAVIGATION IMU MN A and MN B
- e. GUIDANCE/NAVIGATION OPTICS MN A and MN B
- f. GUIDANCE/NAVIGATION POWER AC 1 and AC 2

6.1.4.3 Verify that the ICTC is providing heater power to the G&N System.

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6.2 Test Procedures

6.2.1 Application of Standby Power to G&N System

- 6.2.1.1 Verify that spacecraft power checks, to include polarity and magnitude on Spacecraft Power Connector, have been made as specified in 6.1.3.
- 6.2.1.2 All power and control switches on the G&N Indicator Control Panel shall be placed in the OFF or neutral position.
- 6.2.1.3 The Inertial Component Temperature Controller (ICTC) shall be supplying inertial component heater power to the G&N System through the PSA, Connector No. 45J2.
- 6.2.1.4 Computer Power On
 - 6.2.1.4.1 Set G&N COMPUTER MN A and MN B Breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in).

NOTE: Restart Lamp may illuminate, if it does, disregard and press RSET on the DSKY.
 - 6.2.1.4.2 Set the POWER-AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in), and position G/N POWER switch to AC1.
 - 6.2.1.4.3 Set the computer numerical display lights to the minimum acceptable brightness by rotating the BRIGHTNESS Controls on the MDC and LEB Lighting Control Panels.
 - 6.2.1.4.4 The +28 VDC CMC OPERATE voltage (CG 1520) shall be $+28.8 \pm 3$ VDC. Verify CRT indication.
 - 6.2.1.4.5 Using DSKY, enter VERB 36, ENTR, then press RESET. All computer alarms on the Main Display Console (MDC), LEB CMC DSKY and CRT shall clear.
 - 6.2.1.4.6 The voltage output of the +4 VDC CMC supply shall be $+4.00 \pm 0.20$ VDC (CG 1030). The value on the CRT shall be recorded.
 - 6.2.1.4.7 The voltage output of the +14 VDC CMC supply shall be $+14.0 \pm 0.4$ VDC, (CG 1020). The value on the CRT shall be recorded.
 - 6.2.1.4.8 Verify that the CMC is in the Backup Mode by monitoring on the CRT that the Program indicates 00, and the Program readouts on the MDC and LEB AGC DSKY indicate 00.

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6.2.1.4.9 Zero the CMC erasable memory by entering the following sequence into the K-start:

- a. VERB 57, ENTER
- b. 00015, ENTER

6.2.1.4.10 Initiate CMC self-check by entering the following sequence into the K-start:

- a. VERB 21, NOUN 27 ENTER
- b. 77777, ENTER
- c. VERB 15 NOUN 01 ENTER
- d. 1366, ENTER

6.2.1.4.10.1 Monitor DSKY until R3 (SCOUNT +2) increments twice. If an error is detected, the following will be displayed:

- a. VERB 05 NOUN 31
- b. R1 = 01102
- c. R2 = XXXXX C (SFAIL)
- d. R3 = XXXXX C (ERCOUNT)

6.2.1.4.10.2 Enter the following into the K-start:

- a. VERB 21
- b. NOUN 27, press ENTER pushbutton
- c. 00000, press ENTER pushbutton

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6.2.1.5 IMU HTR Heater Power On

6.2.1.5.1 Enter the IMU Standby Mode of operation by engaging the IMU HTR MN A and MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).

6.2.1.5.2 Verify that the IMU +28 VDC STANDBY discrete lamp on Event Module is illuminated (CG 1513).

6.2.1.5.3 Record the value of the following signals displayed on the CRT.

Signal	Requirement
a. CG 1331 28V 3200 CPS POWER SUPPLY FEEDBACK	28.6 ± 0.6 VRMS
b. CG 1510 + 28 VDC STANDBY POWER	28.8 (±3) VDC

6.2.1.5.4 The PIPA TEMP on the CRT shall be monitored at 15 min., 1 hr. and 2 hrs. from execution of 6.2.1.5.2 to insure that the PIPA Temperature Control Loop circuitry is operating to maintain a temperature of 130.5 ± 1.5F (CG 2300).

6.2.1.5.5 The IRIG TEMP on the CRT shall be monitored at 15 min., 1 hr., and 2 hrs. after 6.2.1.5.2 is executed to insure that the IRIG Temperature (CG 2301) is within ±3.0 degrees of the PIPA Temperature.

6.2.1.5.6 At the termination of the 2-hour period, record the PIPA temperature (CG 2300) on the CRT. On the event recorder verify that the IMU HEATER current discrete (CG 2302) is ON and that the IMU-BLOWER current discrete (CG 2303) is OFF over the last two hour period (occasionally discrete may cycle).

6.2.1.5.7 With the eyepiece in the Eyepiece Storage Unit, check the eyepiece surface temperature at the quick disconnect flange using an L&N #8693 Temperature Potentiometer, or a similar type thermocouple probe meter. Record both the ambient and eyepiece surface temperatures and verify that the eyepiece surface temperature is at least 10°F above the ambient temperature.

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6.2.2 CMC Operational Test

NOTE: This test shall be performed when only IMU HTR and Computer Power is applied. The test shall not be performed when IMU OPERATE power is applied.

6.2.2.1 Verify that IMU STANDBY power (including CMC operate power) is applied, IMU OPERATE power is not applied. (G & N IMU HTR MN A and MN B breakers engaged, Computer MN A and MN B breakers engaged, IMU MN A and MN B breakers disengaged, G/N Power-IMU switch on LEB Lighting Control Panel in OFF Position).

6.2.2.1.1 Using the LEB CMC DSKY, enter VERB 36, ENTER then press RESET.

6.2.2.2 CMC Checks

6.2.2.2.1 Using the LEB CMC DSKY, enter the following sequence of data into the CMC to initiate the DSKY check. Press the ENTER pushbutton after each entry (denoted by E).

VERB 21 NOUN 27, E
 77766, E

6.2.2.2.2 DSKY check shall check all the electroluminescent elements by displaying the decimal numbers from nine through zero in succession, each set of numbers shall be displayed for approximately 5 seconds. Verify all elements operable on MDC and LEB CMC DSKY's. VERB-NOUN display shall flash.

6.2.2.2.3 Minus and plus signs shall be displayed. Verify operation on MDC and LEB DSKY's.

6.2.2.2.4 COMP ACTY lamp shall be illuminated for approximately 5 seconds, then DSKY shall blank.

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6.2.2.3 CAUTION and STATUS Displays

6.2.2.3.1 Enter VERB 35, ENTR, into LEB CMC DSKY.

6.2.2.3.2 The following MDC and LEB CMC DSKY displays shall illuminate for approximately 5 seconds.

- a. UPLINK ACTY
- b. NO ATT
- c. STBY
- d. KEY REL Flashing
- e. TEMP
- f. GIMBAL LOCK
- g. PROG
- h. RESTART
- i. TRACKER
- j. OPR ERROR Flashing
- k. CCMF ACTY
- l. VERB-NOUN Flashing
- m. Plus 88888 in R1, R2, and R3
- n. PGNS, CMC, and ISS caution lights. (CMC shall remain illuminated for 15.5 seconds.)

After indications a through l go out +88888 shall remain in R1, R2, R3.

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6.2.2.4 DSKY Pushbutton Check

6.2.2.4.1 Enter the following sequence into the LEB CMC DSKY. Press the ENTER pushbutton after each entry (denoted by E).

- a. VERB 25 NOUN 01, E
- b. 01600, E
- c. +00123, E
- d. -00456, E
- e. -00789, E

6.2.2.4.2 The LEB CMC DSKY shall indicate +00123 in R1, -00456 in R2, and -00789 in R3.

6.2.2.4.3 Enter VERB 05, NOUN 01 into the LEB CMC DSKY. Press the ENTER pushbutton.

6.2.2.4.4 Enter 01600 into LEB CMC DSKY. Press the ENTER pushbutton. The LEB CMC DSKY shall indicate 00024 in R1, 77664 in R2, and 77576 in R3. Verify.

6.2.2.4.5 Enter the following sequence into the LEB CMC DSKY.

The results shall be as indicated in the following table.

- a) VERB 21 NOUN 01, ENTER
- b) 01600, ENTER
- c) +00123, DO NOT Press ENTER

6.2.2.4.5.1 Press the CLEAR pushbutton. R1 shall clear.

6.2.2.4.6 Enter VERB 16 NOUN 16 into the LEB CMC DSKY. Press the ENTER pushbutton. The Operator Error Light shall light.

6.2.2.4.6.1 Press the RESET pushbutton. The Operator Error light shall extinguish.

6.2.2.4.7 Enter the following sequence into the LEB CMC DSKY. Press the ENTER pushbutton as indicated. The KEY Release Light shall light.

- a) VERB 16, NOUN 20, ENTER
- b) VERB

6.2.2.4.7.1 Press the KEY RELEASE pushbutton. The Key Release Light shall extinguish.

6.2.2.4.7.2 Enter VERB 36, into the LEB CMC DSKY. Press the ENTER pushbutton.

NOTE: 6.2.2.4.8 does not apply to 2TV-1.

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6.2.2.4.8 Enter the following sequence into the LEB CMC DSKY.

- a) VERB 11 NOUN 10, ENTER
- b) 00032, ENTER

Press the STANDBY pushbutton once and verify that "5XXXX" is displayed in R1. Press the STANDBY pushbutton again and verify that "7XXXX" is displayed in R1. Enter VERB 34 and press the ENTER pushbutton.

6.2.2.4.9 Repeat of 6.2.2.4.1 through 6.2.2.4.8, using the MDC CMC DSKY. The results shall be as specified in 6.2.2.4.4.

6.2.2.5 Uplink and Downlink Checks.

6.2.2.5.1 Enter VERB 36 into K148. Press the ENTER pushbutton, then press ERROR RESET pushbutton.

6.2.2.5.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.

- a. VERB 25 NOUN 01 ENTER
- b. 01600, ENTER
- c. 00000, ENTER
- d. 77777, ENTER
- e. 07254, ENTER
- f. VERB 05 NOUN 01, ENTER
- g. 01600, ENTER

6.2.2.5.3 CMC Registers R1, R2, and R3 display on the CRT shall indicate 00000, 77777, and 07254, respectively.

6.2.2.5.4 Set/verify that the UP TLM switch on the Main Display Panel is set to ACCEPT and that the UP TLM switch on the G&N Control Panel is set to BLOCK.

Verify that the BLOCK UPLINK discrete on the CRT is ON.

6.2.2.5.5 On K-148 insert VERB.

Verify that the VERB indication on the DSKY and CRT does not change.

6.2.2.5.6 Set the UP TLM switch on the G&N Indicator Control Panel to ACCEPT. Verify that the BLOCK UPLINK discrete on the CRT is OFF.

6.2.2.5.7 On K-148 insert VERB 01. Verify that the VERB indication on the DSKY and CRT is 01.

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- 6.2.2.5.8 Set the UP TLM switch on the MAIN DISPLAY Panel to BLOCK. Verify that the BLOCK UPLINK discrete on the CRT is ON.
- 6.2.2.5.9 On K-148 insert VERB. Verify VERB indication on the DSKY and CRT does not change.
- 6.2.2.5.10 Set the UP TLM switch on the MAIN DISPLAY Panel to ACCEPT. Verify that the BLOCK UPLINK discrete on the CRT is OFF.
- 6.2.2.5.11 On K-148 insert VERB 36. Press the ENTER pushbutton.

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6.2.2.6 Parity Fail Test

6.2.2.6.1 Enter the following into the K-Start. Press the ENTER pushbutton after each entry.

- a. VERB 57, ENTER
- b. 00015, ENTER
- c. VERB 21 NOUN 02, ENTER
- d. 01600, ENTER
- e. 33777, ENTER
- f. VERB 25 NOUN 26, ENTER
- g. 04000, ENTER
- h. 01600, ENTER
- i. 00003, ENTER
- j. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate.
The PGWS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.6.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PGWS caution lamps shall extinguish.

6.2.2.6.3 Enter VERB 36, into the K-START. Press the ENTER pushbutton.

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6.2.2.7 Rupt Lock Test

6.2.2.7.1 Enter the following sequence into the K-Start. Press the ENTER pushbutton after each entry.

- a. VERB 24 NOUN 01, ENTER
- b. 01600, ENTER
- c. 30001, ENTER
- d. 01600, ENTER
- e. VERB 25 NOUN 26, ENTER
- f. 00001, ENTER
- g. 01600, ENTER
- h. 00003, ENTER
- i. VERB 31, ENTER

The RESTART lamps on the MDC and LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.7.2 Press the ERROR RESET pushbutton on the K-START. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.7.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

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6.2.2.8 TC Trap Test

6.2.2.8.1 Enter the following sequence into the K-Start. Press the ENTER pushbutton after each entry.

- a. VERB 21 NOUN 02, ENTER
- b. 01600, ENTER
- c. 01600, ENTER
- d. VERB 25 NOUN 26, ENTER
- e. 04000, ENTER
- f. 01600, ENTER
- g. 00003, ENTER
- h. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.8.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.8.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

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6.2.2.9. Nightwatchman Test

6.2.2.9.1 Enter the following sequence into the K-Start. Press ENTER pushbutton after each entry.

- a. VERB 24 NOUN 01, ENTER
- b. 01600, ENTER
- c. 30001, ENTER
- d. 01600, ENTER
- e. VERB 25 NOUN 26, ENTER
- f. 04000, ENTER
- g. 01600, ENTER
- h. 00003, ENTER
- i. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on MDC and LEB CMC DSKY and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.9.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.9.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

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- 6.2.2.10 CMC Clock Frequency Test**
- 6.2.2.10.1** Insure that the CMC is in the Standby Mode by verifying that the STBY push-button on the DSKY's is lit. If it is not lit enter VERB 60, ENTER into the DSKY. Push and hold the STBY pushbutton until it lights. Verify that the NO ATT and TEMP lamps on the DSKY's light.
- 6.2.2.10.2** Insure that the IMU 3.2 kc 28V Supply is available on the vertical input to PIPA Scope.
- 6.2.2.10.3** Insure that the EPUT Meter and preset counter plug-in unit are connected to 115V, 60 cps power.
- 6.2.2.10.3.1** Permit the EPUT to warm up for the length of time required by the manufacturer's specification.
- 6.2.2.10.4** Connect the signal output from Oscilloscope 4A4-A1 to the input channel on the EPUT Meter.
- 6.2.2.10.5** Set the preset counter to indicate 96000.
- 6.2.2.10.6** Set the EPUT meter to count at the maximum count rate (1 megacycle or greater).
- 6.2.2.10.7** Adjust the Trigger Level to the point midway between the range over which the counter will normally count.
- 6.2.2.10.8** Each count cycle shall last approximately 30 seconds. Adjust the display time to permit recording the display on the EPUT.
- 6.2.2.10.9** Record the results of 10 count-cycles. Calculate the average time per cycle over the 10 cycles. Record the result. The average of the 10 previous readings shall be 30.000000±0.000080 seconds.
- 6.2.2.10.10** Remove the CMC from Standby Mode by performing the following DSKY operations.
- Press and hold the STBY pushbutton until it extinguishes.
 - Press the RESET pushbutton.
 - VERB 61, ENTER
 - VERB 36, ENTER.

NOTE: Restart Lamp may illuminate; if it does, disregard and press RSET on the DSKY.

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- 6.2.2.11 Mark and Mark Reject pushbutton test.
- 6.2.2.11.1 On the G&N Indicator Control panel press and hold MARK pushbutton.
- 6.2.2.11.2 On the DSKY observe
VERB 05 NOUN 31
Row 1 = 00114
Prog Alarm lamp is lighted
Press ERR RSET
- 6.2.2.11.3 Enter the following on K-148.
VERB 11 NOUN 10 ENTER
00016 ENTR
- 6.2.2.11.4 Observe that DSKY Row 1 displays 00040.
- 6.2.2.11.5 Release MARK pushbutton
- 6.2.2.11.6 Observe that DSKY Row 1 displays 00000.
- 6.2.2.11.7 Press and hold the REJECT pushbutton on the G&N Indicator Control Panel.
- 6.2.2.11.8 On the DSKY observe
VERB 05 NOUN 31
ROW 1 = 00112
Prog Alarm lamp is lighted
Press ERR RSET
- 6.2.2.11.9 Observe that DSKY Row 1 displays 00100.
- 6.2.2.11.10 Release the REJECT pushbutton.
- 6.2.2.11.11 Observe that DSKY Row 1 displays 00000.
- 6.2.2.11.12 On the DSKY Perform the following operation:
VERB 36 ENTR
- 6.2.2.12 Minimum Impulse Controller Input Test
- 6.2.2.12.1 Enter the following into the DSKY.
a. VERB 11 NOUN 10, ENTR
b. 00032, ENTR
- 6.2.2.12.2 Set the Minimum Impulse Controller on the Indicator Control Panel to the following position and observe R1 of the DSKY for the proper indications.
- | <u>MIC Position</u> | <u>R1 DSKY Indication</u> |
|---------------------|---------------------------|
| a. Up | 77775 |
| b. Down | 77776 |
| c. Left | 77737 |
| d. Right | 77757 |

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MIC Position

R1 DSKY Indication

e. Clockwise	77773
f. Counterclockwise	77767
g. Neutral	77777

6.2.2.12.3 Enter VERB 34, ENTER into the DSKY.

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6.2.3 Operate Power On Test

6.2.3.1 IMU Operate Power On

CAUTION: The sequences specified in this test must be adhered to. Deviations may necessitate recalibration of the inertial components.

NOTE: Disregard the GIMBAL LOCK indicator until the completion of step 6.2.3.1.6.

6.2.3.1.1 The following Command Module switches and circuit breakers shall be in the following state:

Right Hand Circuit Breaker Panel

- a. GUIDANCE/NAVIGATION COMPUTER MN A and MN B breakers on (pushed in)
- b. GUIDANCE/NAVIGATION IMU HTR MN A and MN B breakers on (pushed in)
- c. GUIDANCE/NAVIGATION IMU MN A and MN B breakers off (pulled out)
- d. GUIDANCE/NAVIGATION OPTICS MN A and MN B breakers off (pulled out)

LEB Lighting Control Panel

- e. G/N Power - IMU set to OFF
- f. G/N Power - Optics set to OFF

6.2.3.1.2 Switches and selectors on the G & N Indicator control panel shall be set as follows:

- a. OPTICS MODE to MANUAL
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to MED
- d. TELESCOPE TRUNNION to SLAVE to SXT
- e. RETICLE BRIGHTNESS to minimum brightness position

6.2.3.1.3 Adjust the Command Module MDC and LEB Lighting Controls to minimum intensity for proper readout of G & N Displays.

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6.2.3.1.4 Set up the ACE analog recorders to monitor the following measurements (set chart speed to 5 mm/sec):

- a. CG 2117 IGA Servo Error In Phase
- b. CG 2177 OGA Servo Error In Phase
- c. CG 2147 MGA Servo Error In Phase
- d. CG 2112 IG IX Resolver Output Sin
- e. CG 2172 OG IX Resolver Output Sin
- f. CG 2142 MG IX Resolver Output Sin
- g. CG 1040 +120 VDC PIPA Supply DC Level

CAUTION: Before proceeding, insure that the G & N System has been operating in the STANDBY MODE (power configuration as defined in 6.2.3.1) for a minimum period of 2 hours. Exceptions to this requirement are noted in 6.2.5.2.9.

CAUTION NOTE: If the requirements of 6.2.3.1.6 are not met, remove IMU operate power immediately by placing the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

6.2.3.1.5 Perform the following sequence:

- a. Turn on the IMU MNA and MN B circuit breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).
- b. Start Analog Recorders.
- c. Place G/N Power - IMU switch on the LEB Lighting Control Panel to IMU (switch toggle up).

6.2.3.1.6 Immediately begin monitoring the following measurements.

- a. The IMU Operate Power is $+28.8 \pm 3$ vdc (CG 1500). Verify on CRT.
- b. On the recorders, verify that oscillations are not sustained and that a null is achieved within 10 seconds of power application in 6.2.3.1.5 on the following measurements:

CG 2112, IG IX Resolver Output Sin
CG 2142, MG IX Resolver Output Sin
CG 2172, OG IX Resolver Output Sin
- c. On the CRT, verify that the following signals are between +3 to +5 V rms or -3 to -5 V rms for a period of approximately 90 sec. After approximately 100 sec the following signals shall be less than ± 1.0 V rms.

CG 2001, X PIPA SG OUTPUT IN PHASE
CG 2021, Y PIPA SG OUTPUT IN PHASE
CG 2041, Z PIPA SG OUTPUT IN PHASE
- d. On the CRT, verify the absence of the +120 VDC PIPA supply (CG 1040) for a period of 90 ± 10 seconds following power application in 6.2.3.1.5. After approximately 100 seconds, the voltage shall read $+120 \pm 6$ VDC.

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6.2.3.1.7 Insure that the following alarm lamps are not lighted on G&N LEB Display Panel.

- a. CMC Warning
- b. ISS Warning
- c. PGNS Caution

6.2.3.1.8 Verify that the PROGRAM ALARM lamp on the DSKY's does not light with VERB 05 NOUN 31 and R1 = 00213 displayed.

6.2.3.1.9 The OG, IG, and MG CDU angles shall be 00000±00150. Verify on CRT.

6.2.3.1.10 Enter the following into K-148:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.3.1.11 Verify that the following secondary power supply voltages are not flashing on the CRT display.

Table VI. Secondary Power Supply Voltages

Meas. No.	Signal
1 CG 1040	+120 VDC PIPA SUPPLY
2 CG 1051	+20 VDC PIPA SUPPLY
3 CG 1052	-20 VDC PIPA SUPPLY
4 CG 1070	+4 VDC CDU SUPPLY
5 CG 1100	-28 VDC ELECTRONICS
6 CG 1020	+14 VDC CMC SUPPLY
7 CG 1030	+4 VDC CMC SUPPLY
8 CG 1201	IMU 28V 800 CPS 1 pct 0 ph
9 CG 1202	IMU 28V 800 CPS 5 pct ph A
10 CG 1203	IMU 28V 800 CPS 5 pct ph B
11 CG 1331	3.2KC 28V SUPPLY
12 CG 1110	2.5 VDC TM BIAS

6.2.3.1.12 15 minutes after the application of IMU OPERATE power record PIPA TEMP (CG 2300) displayed on the CRT.

6.2.3.1.13 Deleted, after the application of IMU OPERATE power record PIPA TEMP (CG 2300) displayed on the CRT.

6.2.3.1.14 1 hour after the application of IMU OPERATE power monitor and record PIPA TEMP (CG 2300) every 5 minutes for 1 hour. Verify that each reading does not deviate from the average of each signal by more than 0.1°F. For the temperature, order verify that CG 2303, IMU BLOWER CURRENT is OK.

6.2.3.1.15 When 2 hours have elapsed since the application of IMU OPERATE power record PIPA TEMP. PIPA TEMP shall be 130.5° ±1.5°F. PIPA TEMP shall be within 0.5°F of that recorded in 6.2.3.1.12 and 6.2.3.1.14. For the temperature, order verify that CG 2303, IMU BLOWER CURRENT is OK.

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6.2.3.2 Optics Power On

6.2.3.2.1 Optics power shall be applied by actuating the G&N OPTICS MN A and OPTICS MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in), and placing G/N Power - OPTICS switch on the LEB Lighting Control Panel to ON.

6.2.3.2.2 OPTICS +28 VDC discrete shall be issued (CG 1533). Verify by observing that the OPTICS lamp on Event Module is illuminated. Verify that the +28 VDC OPTX OPERATE BUS (CG 1530) is +28.8±3 VDC. Record the indication on the CRT.

6.2.3.2.3 Verify the following secondary power supply voltages on the CRT are not flashing:

CG 1211 OPTX 28V 800 CPS 1 pct 0 ph
CG 1212 OPTX 800 CPS 5 pct-90 ph

6.2.3.3 IMU Cage Test

6.2.3.3.1 Enter the following into the DSKY:

- a. VERB 40 NOUN 20, ENTER (wait 3 seconds)
- b. VERB 41 NOUN 20, ENTER
- c. +00200, ENTER
- d. +00200, ENTER
- e. +00200, ENTER

Observe that the NO ATT lamps on the DSKY's light and that CDUX, CDUY, CDUZ on the CRT indicate approximately +00200.

6.2.3.3.2 Set up the Analog Recorder to monitor the following signals:

- a. IG 1X Resolver Output Sine (CG 2112)
- b. MG 1X Resolver Output Sine (CG 2142)
- c. OG 1X Resolver Output Sine (CG 2172)

Start the Analog Recorders.

6.2.3.3.3 On MDC panel 1, press and hold the IMU CAGE switch in the CAGE position. On the Analog Recorder, verify that the 1X Sine signals (CG 2112, CG 2142, and CG 2172) null out at 0.5V rms or less.

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- 6.2.3.3.4 Release the IMU CAGE switch. Disregard any momentary transients on the 1X Resolver Sine signals when the switch is released. Sustained oscillations shall be cause for immediate removal of IMU OPERATE power.
- 6.2.3.3.5 On the CRT verify that CDUX, CDUY and CDUZ are all between +00150 and +35850.
- 6.2.3.3.6 Stop the Analog Recorders.
- 6.2.4 G&N System Power Supplies Test
- 6.2.4.1 Proceed with this test if 6.2.3, Operate Power On Test, has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding with this test. Insure that the IMU Operate Power has been on for at least 15 minutes before proceeding with this test.
- 6.2.4.2 Enter the following sequence into the K-Start. Verb 41 NOUN 20, ENTER; +00000 ENTER; +00000 ENTER, +00000 ENTER.
- 6.2.4.3 Set/Verify the following circuit breakers and switches on the Right Hand Circuit Breaker Panel and LEB.
- COMPUTER MN A to ON (pushed in) and COMPUTER MN B to OFF (pulled out).
 - G/N - POWER to AC1
 - IMU HTR MNA to ON (pushed in) and IMU HTR MNB to OFF (pulled out).
 - IMU MNA to ON (pushed in) and IMU MN B to OFF (pulled out).
 - G/N POWER - IMU to IMU
 - OPTICS MNA to ON (pushed in) and OPTICS MN B to OFF (pulled out).
 - G/N POWER - OPTICS to OPTICS
- 6.2.4.4 Record the voltage indicated on the CRT for the following signals:
- The +28 VDC IMU OPERATE (Buss No. 1) output voltage shall be $+28.8 \pm 3$ VDC (CG 1500).
 - The +28 VDC IMU STANDBY (Buss No. 2) output voltage shall be $+28.8 \pm 3$ VDC (CG 1510).
 - The +28 VDC CMC OPERATE (Buss No. 3) output voltage shall be $+28.8 \pm 3$ VDC (CG 1520).
 - The +28 VDC OPTX OPERATE (Buss No. 4) output voltage shall be $+28.8 \pm 3$ VDC (CG 1530).
 - The CG 2221, IGA CDU Coarse Error measurement shall be 0.0 ± 0.68 VRMS
 - The CG 2251 MGA CDU Coarse Error measurement shall be 0.0 ± 0.68 VRMS
 - The CG 2281 OGA CDU Coarse Error measurement shall be 0.0 ± 0.68 VRMS

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6.2.4.5 Record the voltage indicated on the CRT for the following power supplies:

- a. The +120 VDC PIPA Power Supply output voltage shall be 120 ± 6 VDC (CG 1040).
- b. The +20 VDC PIPA Power Supply output voltage shall be 20.0 ± 1.2 VDC (CG 1051).
- c. The -20 VDC PIPA Power Supply output voltage shall be -20 ± 2 VDC (CG 1052).
- d. The -28 VDC Electronics Power Supply output voltage shall be -28.5 ± 6.0 VDC (CG 1100).

6.2.4.6 The following values shall be measured with the guidance reference clock synchronizing input pulse. Record the voltage indicated on the CRT.

- a. IMU 28V, 800 CPS 1% 0 deg. voltage shall be 28.0 ± 0.6 VAC (CG 1201).
- b. IMU 28V, 800 CPS, 5% PHA - 90 deg. voltage shall be 28.0 ± 1.4 VAC (CG 1202).
- c. IMU 28V, 800 CPS, 5% PHB 0 deg. voltage shall be 28.0 ± 2.1 VAC (CG 1203).
- d. Optics 28V, 800 CPS 1% 0 deg. voltage shall be 28.0 ± 0.6 VAC (CG 1211).
- e. Optics 28V, 800 CPS 5% - 90 deg. voltage shall be 28.0 ± 1.5 VAC (CG 1212).
- f. PH Diff IMU 5% 0 deg. -90 deg. (CG 1207) phase difference shall be $-90^\circ \pm 10^\circ$.
- g. Ph Diff Optics 1% IMU 1% (CG1220) phase difference shall be $0^\circ \pm 10^\circ$.

6.2.4.7 Record the voltages indicated on the CRT for the following power supplies:

- a. The +14 VDC CMC Power Supply output voltage shall be $+14.0 \pm 0.4$ VDC (CG 1020).
- b. The +4 VDC CMC Power Supply output voltage shall be $+4.0 \pm 0.2$ VDC (CG 1030).
- c. The +4 VDC CDU Power Supply output voltage shall be $+4.0 \pm 0.2$ VDC (CG 1070).
- d. The +2.5 VDC TM BIAS SUPPLY output voltage shall be $+2.50 \pm 0.05$ VDC (CG 1110).

6.2.4.8 Record the CRT indications for the following measurements:

- a. The 28V, 3200 CPS Power Supply feedback output voltage shall be 28.6 ± 0.6 VRMS (CG 1331).
- b. The phase difference between the 3.2Kc supply and CMC sync shall be $0^\circ \pm 10^\circ$ (CG 1336).
- c. The +14 VDC CMC power Supply RMS noise shall be less than 0.4 volts p-p (CG 1021).
- d. The +4 VDC CMC Power Supply noise peaks shall be less than 0.4 volts p-p (CG 1031).

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- 6.2.4.9 Set/Verify the following circuit breakers and switches on the Right Hand Circuit Breaker Panel and LEB:
- G/N POWER-OPTICS to OFF
 - OPTICS MN B to ON (pushed in) and OPTICS MN A to OFF (pulled out).
 - G/N POWER - IMU to OFF
 - IMU MN B to ON (pushed in) and IMU MN A to OFF (pulled out).
 - IMU HTR MNA to OFF (pulled out)
 - G/N - POWER to OFF
 - COMPUTER MN B to ON (pushed in) and COMPUTER MN A to OFF (pulled out).
- 6.2.4.10 Verify that the +28 VDC CMC OPERATE output voltage is $\pm 28.8 \pm 3$ VDC (CG 1520).
- 6.2.4.11 Set the G/N - POWER switch on the LEB to AC2. Set the IMU HTR MN B to ON (pushed in). Verify that the +28 VDC IMU STANDBY output voltage is $\pm 28.8 \pm 3$ VDC (CG 1500).
- 6.2.4.12 Wait until 15 minutes have elapsed since setting G/N POWER - IMU to OFF in 6.2.4.9.c then set the G/N POWER - IMU to IMU. Verify that the +28 VDC IMU OPERATE output Voltage is $\pm 28.8 \pm 3$ VDC. (CG 1500).
- 6.2.4.13 Set the G/N POWER - OPTICS to OPTICS. Verify that the +28 VDC OPTX OPERATE output voltage is $\pm 28.8 \pm 3$ VDC (CG 1530).
- 6.2.4.14 Repeat 6.2.4.5 through 6.2.4.8.
- 6.2.4.15 Set the following circuit breakers to the position indicated:
- Set the COMPUTER MN A to ON (pushed in).
 - Set the IMU HTR MNA to ON (pushed in).
 - Set the IMU MNA to ON (pushed in).
 - Set the OPTICS MN A to ON (pushed in).
- 6.2.4.16 Miscellaneous Checks - The following miscellaneous signals are required to supply data for system evaluation in the event of failure, or for trend analysis of system performance. Record the values displayed on the CRT for the following signals.
- CG 4300 CMC Temperature
 - CG 6020 PIPA Calibration Module Temperature
 - CG 6021 IMU 800 CPS 5% Temperature

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- 6.2.4.17 Verify and record the following signals displayed on the CRT:
- +120 VDC PIPA SUP. NOISE RMS shall be less than 1.5 VRMS (CG 1042)
 - +20 VDC PIPA SUP NOISE RMS shall be less than 1.0 VRMS (CG 1053)
 - +4 VDC CDU SUP NOISE RMS shall be less than 1.0 VRMS (CG 1071)
 - +28V IMU OPERATE BUS NOISE RMS shall be less than 1.0 VRMS (CG 1501)
 - +28V IMU STANDBY BUS NOISE RMS shall be less than 1.0 VRMS (CG 1511)
 - +28V CMC OPERATE BUS NOISE RMS shall be less than 2.0 VRMS (CG 1521).
 - +28V OPTX OPERATE BUS NOISE RMS shall be less than 2.0 VRMS (CG 1531).
- 6.2.4.18 The noise peaks of the following signals are demonstrated on the event lights when the peaks have a rise time between 2 and 50 μ sec and the peak voltage exceeds 5 volts.
- +14V CMC SUPPLY NOISE PEAKS (CG 1022)
 - +4V CMC SUPPLY NOISE PEAKS (CG 1032)
 - +120 VDC PIPA SUPPLY NOISE PEAKS (CG 1043)
 - +4 VDC CDU SUPPLY NOISE PEAKS (CG 1072)
 - +28V IMU OPERATE BUS NOISE PEAKS (CG 1502)
 - +28V IMU STANDBY BUS NOISE PEAKS (CG 1512)
 - +28V CMC OPERATE NOISE PEAKS (CG 1522)
 - +28V OPTX OPERATE NOISE PEAKS (CG 1532)
- 6.2.4.19 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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6.2.5 General Turn Off and Turn On Procedure

NOTE: This procedure shall be utilized any time after performing 6.1.3 Prepower Application Requirements, 6.2.1, Standby Power On Test, and 6.2.3. Operate Power on Test, to turn on or turn off the G&N System. Appropriate portions of this procedure will be referenced in other tests.

6.2.5.1 Turn Off Procedure

CAUTION: This procedure must be performed in the sequence specified. Failure to adhere to this sequence may require calibration of the inertial components.

6.2.5.1.1 Enter the following sequence into the K-148.

- a. VERB 41 NOUN 20, ENTER
- b. +00000 ENTER
- c. +00000 ENTER
- d. +09000 ENTER

Verify that the GIMBAL LOCK indicator on the DSKY's is illuminated.

6.2.5.1.2 Set the following switches on the G&N Indicator Control Panel to the positions designated.

- a. OPTICS MODE to MANUAL
- b. CONTROLLER MODE to DIRECT
- c. CONTROLLER SPEED to LOW
- d. TELESCOPE TRUNNION to SLAVE TO SXT
- e. RETICLE BRIGHTNESS to minimum brightness position

6.2.5.1.3 Set the G/N Power - IMU switch on the LEB Lighting Control Panel to OFF and G&N IMU MN A and MN B circuit breakers on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).

6.2.5.1.4 Decrease the LIGHTS - NUMERICS controls on both the Left Hand Circuit Breaker panel and the LEB Lighting Control Panel to the minimum brightness - OFF position.

6.2.5.1.5 Set the PSAAM power switch on the PSAAM of OFF. (The Right Hand Circuit Breaker panel to OFF (breakers pulled out)).

6.2.5.1.6 Set the IMU HTR MN A and MN B circuit breaker on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).

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- 6.2.5.1.7 Set the G&N Power AC1-OFF-AC2 Switch on the Right Hand Circuit breaker panel to OFF and the G&N POWER AC1 and AC2 circuit breakers to OFF (breakers pulled out).
- 6.2.5.1.8 Set the G/N POWER - OPTICS switch on the LEB Lighting Control Panel to OFF and G&N OPTICS MN A and MN B breakers on the Right Hand circuit breaker panel to OFF.
- 6.2.5.1.9 Set the COMPUTER MN A and MN B Circuit breakers on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).
- 6.2.5.1.10 Verify that the ICTC is supplying inertial components heater power to the G&N System; This will be indicated by the following on the PTC.
- a. G&N ON (PTC inhibit) light not illuminated.
 - b. IMU Temp/heater current meter indicates IMU temperature of 130° ±5°F.
- 6.2.5.2 Turn ON Procedure
- 6.2.5.2.1 Set or verify the following G&N Indicator Control Panel switches to the position indicated.
- a. CONDITION LAMPS to ON
 - b. OPTICS MODE to MANUAL
 - c. CONTROLLER COUPLING to DIRECT
 - d. CONTROLLER SPEED to LOWEST
 - e. TELESCOPE TRUNNION to SLAVE to SXT
 - f. RETICLE BRIGHTNESS to minimum brightness position.
- 6.2.5.2.2 Insure that interfacing system EPS and ECS are turned on and operating properly.
- CAUTION: The remaining procedure must be followed in sequence specified. Failure to adhere to this sequence may require recalibration of the inertial components.

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- 6.2.5.2.3 Energize the G&N COMPUTER MNA and MNB breakers on the Right Hand Circuit Breaker panel (Breakers pushed in). Enter VERB 61 into K148 and press the ENTER pushbutton. Verify +14 and +4 VDC CMC power supply outputs on CRT display. Voltages shall be +14.0±0.4 VDC (CG 1020) and +4.0±0.3 VDC (CG 1030). NOTE: +14 and +4 VDC CMC power supply outputs of NOTE: Restart Lamp may illuminate; if it does, (disregard and press 2 VDC (CG 1020) RSET on the DSKY.
- 6.2.5.2.4 Energize the G&N IMU HTR MNA and MNB breakers on the Right Hand Circuit Breaker panel (breakers pushed in). Insure that the CMC +28 VDC discrete lamp on the Event Module is illuminated (CG 1523).
- 6.2.5.2.5 Set the G&N POWER AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in). Set the G&N POWER AC1-OFF-AC2 switch to AC1.
- 6.2.5.2.5.1 Set the G&N DSKY and Display Panel brightness to the minimum acceptable level by manipulation of LIGHTS - NUMERICS control on both Left Hand circuit breaker panel and LEB light Control panel.
- 6.2.5.2.5.2 Set/Verify the following switches on the PSAAM.
- PSAAM POWER to ON
 - INHIBIT VOLTAGE FAIL to OFF.
- 6.2.5.2.6 Disregard all alarm indications on the CMC DSKY panels. Enter VERB 36 into K148. Press ENTER pushbutton. Press ERROR RESET pushbutton on K-Start. All computer alarms except the Gimbal Lock Indicator on the Main Display Console (MDC) and LEB AGC DSKY shall clear. Verify registers R1, R2, and R3 on the DSKY's are cleared.
- 6.2.5.2.7 Clear the CMC erasable memory by entering the following sequence into the K-Start.
- VERB 47, press ENTER
 - 00015, press ENTER
- 6.2.5.2.8 Initiate CMC Self-Test by entering the following into the K-Start:
- VERB 21 NOUN 27, ENTER
 - 77777, ENTER
 - VERB 15 NOUN 01, ENTER
 - 01366, ENTER
- 6.2.5.2.8.1 Monitor DSKY until R3 (SCOUNT+2) increments twice. If an error is detected, the following will be displayed:
- VERB 05 NOUN 31
 - R1 = 01102
 - R2 = XXXXX c (SFAIL)
 - R3 = XXXXX c (ERCOUNT)
- 6.2.5.2.8.2 Terminate Self-Test by entering the following into the K-Start:
- VERB 21 NOUN 27, ENTER
 - 00000, ENTER

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NOTE: Allow 2 hours to elapse before proceeding to 6.2.5.2.9 with the following exceptions:

- a. If the G&N System has been in the power off state for less than 5 days with the gimbals in the parked position (0°, 0°, 90°) and the system has not been moved, allow 15 minutes to elapse before proceeding.
- b. If the G&N System has been turned off with the gimbals in the unparked position for less than 2 hours allow a warmup time equal to the time off but not less than 15 minutes to elapse before proceeding.

CAUTION: If the requirements of 6.2.5.2.10 are not met, remove IMU Operate Power immediately by setting the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

- 6.2.5.2.9** After the required warmup time has elapsed set the G&N IMU MN A and MN B circuit breaker on the Right Hand circuit breaker panel to ON (breaker pushed in), and the G/N POWER - IMU switch on the LEB Lighting Control panel to the ON position (toggle up).

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- 6.2.5.2.10 Immediately begin monitoring the following measurements.
- On the CRT verify that IMU Operate Power is $\pm 28.8 \pm 3$ VDC (CG 1500).
 - On the meter modules verify that oscillations are not sustained and that a null is achieved within 10 seconds of power application on the following measurements:

CG 2112	IG 1X Resolver Output Sin
CG 2142	MG 1X Resolver Output Sin
CG 2172	OG 1X Resolver Output Sin
 - On the CRT verify the absence of the +120 VDC PIPA Supply (CG 1040) for a period of 90 ± 10 seconds following power application. After approximately 100 seconds, the voltage shall read $+120 \pm 6$ VDC.
- 6.2.5.2.11 Verify that the PROGRAM ALARM lamp on the DSKY's does not light with VERB 05 NOUN 31 and R1 = 00213 displayed.
- 6.2.5.2.12 Enter and verify VERB 40, NOUN 20 into K148. Press the ENTER pushbutton.
- 6.2.5.2.13 Enter and verify VERB 41, NOUN 20 into K148. Press the ENTER pushbutton to advance the System to the Coarse Align mode. The VERB-NOUN display on the CRT shall flash and indicate 21-22.
- 6.2.5.2.14 Enter and verify +00000 into K148 three times, pressing the ENTER pushbutton on the K-START after each entry.
- 6.2.5.2.15 Set the G&N OPTICS MN A and MN B circuit breakers on the Right Hand circuit breaker panel to the ON position (breaker pushed in).

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6.2.5.2.16 Verify that the CRT indications of the signals in Table VI are not flashing.

Table VI. Secondary Power Supply Voltages

Measurement Number	Signal
1 CG 1040	+120 VDC PIPA SUPPLY
2 CG 1051	+20 VDC PIPA SUPPLY
3 CG 1052	-20 VDC PIPA SUPPLY
4 CG 1070	+4 VDC CDU SUPPLY
5 CG 1100	-28 VDC ELECTRONICS
6 CG 1020	+14 VDC CMC SUPPLY
7 CG 1030	+4 VDC CMC SUPPLY
8 CG 1201	IMU 28V 800 CPS 1 pct 0 ph
9 CG 1202	IMU 28V 800 CPS 5 pct ph A
10 CG 1203	IMU 28V 800 CPS 5 pct ph B
11 CG 1331	3.2 KC 28V SUPPLY
12 CG 1110	2.5 VDC TM BIAS
13 CG 2300	PIPA TEMPERATURE

6.2.5.2.17 Monitor the PIPA Display Scope to insure that each PIPA is moding properly.

6.2.5.2.18 Perform 6.2.6 G&N Operational Test.

6.2.5.3 Master Initialization

6.2.5.3.1 Set/Verify the following Circuit Breakers to ON.

- a. G&N COMPUTER MN A & MN B
- b. G&N POWER AC1 & AC2
- c. G&N IMU HTR MNA & MNB

NOTE: If IMU OPERATE POWER is not ON, refer to paragraph 6.2.5.2.9.

- d. G&N IMU MNA & MNB

6.2.5.3.2 Verify/Record the following measurements:

- a. PIPA Temperature (CG 2300) $130 \pm 1.5^\circ\text{F}$.
- b. +28 VDC CMC OPERATE BUS (CG 1520) 28.8 ± 3 VDC.

NOTE: If the GIMBAL LOCK light on the DSKY is lit, proceed to paragraph 6.2.5.3.5.

6.2.5.3.3 Enter VERB 36, ENTER into K148.

6.2.5.3.4 Enter VERB 40 NOUN 20, ENTER into K148.

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6.2.5.3.5 Enter the following into K148:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

Observe the NO ATT lamp lights and the Inner, Outer, and Middle Gimbal angles are $0 \pm 1.5^\circ$ as indicated by the CDUX, CDUY, and CDUZ displays on the CRT.

6.2.5.3.6 Insure that the following switches are set to the positions indicated.

- a. CONTROLLER COUPLING to DIRECT
- b. OPTICS MODE to MAN
- c. TELESCOPE TRUNNION to SLAVE TO SXT
- d. TRACKER to OFF
- e. CONTROLLER SPEED to LO
- f. CONDITION LAMPS to ON
- g. UP TELEMETRY to ACCEPT

6.2.5.3.7 Press the ERROR RESET pushbutton. Enter the following into K148.

- a. VERB 57, ENTER
- b. 00015, ENTER

6.2.6 G&N Operational Test

6.2.6.1 Initial Conditions

Proceed with this test if the Operate Power On Test of 6.2.3 or the Turn on Procedure of 6.2.5 has been completed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding.

6.2.6.1.1 Enter the following into K-148:

- a. VERB 01 NOUN 10, ENTER
 - b. 00003, ENTER
- Record R1 = AAAAA and the time of day

6.2.6.1.2 Enter the following into K-148.

- a. VERB 21 NOUN 02, ENTER
 - b. 01300, ENTER
 - c. AAAAA, ENTER (from 6.2.6.1.1)
 - d. VERB 06 NOUN 02, ENTER
 - e. 01300, ENTER
- Record R1 = BBBB

6.2.6.1.3 Perform the following calculations:

- a. $\frac{R1 (BBBB) \times 5.12}{3600} = CC.C$ (hours in high order scaler Channel 03)

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- b. 23.3 - CC.C = DD.D hours
- c. Add DD.D to the time of day recorded in 6.2.6.1.1. This is the time of day at which the high order scalar, channel 03, will overflow.

Do not enter the G&N Operational test within -0.2 hours of the time of day calculated in step 6.2.6.1.3c. If the test is in process at this time, unacceptable test results will occur.

6.2.6.2 Initiation

6.2.6.2.1 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.6.2.2 Enter 00004 into K148. Press the ENTER pushbutton.

6.2.6.2.3 Observe VERB 16 NOUN 20 displayed on CRT. The NO ATT discrete shall appear momentarily then go OFF. Verify that the PROGRAM displayed on the CRT indicates 07.
Enter VERB 34 into K148 and press the ENTER pushbutton.

NOTE: During this portion of the test the G&N System is exercised through its modes. Any failures will be indicated by the PROGRAM ALARM lamp on the DSKY's lighting with VERB 05 NOUN 31 and R1 = 01411 displayed.

6.2.6.2.4 After approximately 12 minutes, VERB 06, NOUN 66 will flash and the value of the gravity vector in cm/sec^2 shall be displayed in R1 and R2 on the CRT. Record these values.

6.2.6.2.5 R1 contains the first five digits of the gravity vector and R2 contains the last five digits. A decimal point shall be between them. The value for the gravity vector shall be $980.00000 \pm 05.00000 \text{ cm/sec}^2$.

6.2.6.2.6 Enter VERB 33 into K148. Press the ENTER pushbutton.

6.2.6.2.7 When VERB 06 NOUN 66 flashes the value of the horizontal earth rate shall be displayed on R1 and R2 on the CRT. Record these values.

6.2.6.2.8 R1 contains the first five digits of earth rate and R2 contains the last five digits. A decimal point shall be placed between them. R1 shall always be 00000. The horizontal earth rate shall be 00000.83000 ± 0.1000 earth rate units.

6.2.6.3 Test Termination

6.2.6.3.1 Enter VERB 36 into K148. Press the ENTER pushbutton.

6.2.6.3.2 Enter VERB 41, NOUN 20 into K148. Press the ENTER pushbutton.

6.2.6.3.3 Enter +00000 into K148 three times. Press the ENTER pushbutton after each entry.

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6.2.7 Gimbal Friction Test

6.2.7.1 Perform Master Initialization, 6.2.5.3, before proceeding.

6.2.7.1.1 Enter the following into the K-START

VERB 41 NOUN 20 ENTER
+17000 ENTER
+17000 ENTER
+17000 ENTER

6.2.7.1.2 Verify on the CRT that R1 = +17000, R2 = +17000 and R3 = +17000. Wait 15 seconds and enter the following into the K-START.

VERB 41 NOUN 20 ENTER
+27000 ENTER
+27000 ENTER
+27000 ENTER

6.2.7.1.3 Verify on the CRT that R1 = +27000, R2 = 27000 and R3 = 27000. Wait 15 seconds and enter the following:

VERB 41 NOUN 20 ENTER
+00000 ENTER
+00000 ENTER
+00000 ENTER

6.2.7.1.4 Verify on the CRT that R1 = +00000, R2 = +00000 and R3 = +00000. Wait 15 seconds before proceeding.

6.2.7.2 Inner Gimbal Friction Test

6.2.7.2.1 Set up the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

- a. CG 2120 IG TORQUE MOTOR CURRENT
- b. CG 2117 IGA SERVO ERROR IN PHASE
- c. CG 2112 IG 1X RESOLVER OUTPUT SIN
- d. CG 2113 IG 1X RESOLVER OUTPUT COS
- e. CG 2220 IGA CDU FINE ERROR
- f. CG 2221 IGA CDU Coarse Error

6.2.7.2.2 Enter the following into K148.

- a. VERB 01 NOUN 01, ENTER
 - b. 00362, ENTER
- Record R1 = XXXXY

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6.2.7.2.3 Enter the following into K148.

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table 1 and XXXX is that recorded in 6.2.7.2.2.

TABLE I

Y (From 6.2.7.2.2)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.7.2.4 Enter the following sequence into the K-Start, pushing the ENTER pushbutton after each entry (+360 kg torquing).

- a. VERB 24 NOUN 01, ENTER
- b. 00407, ENTER
- c. 40000, ENTER
- d. 40034, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

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- 6.2.7.2.5 Enter the following sequence into K-Start:
- VERB 42, press ENTER
 - VERB 33, press ENTER (verify VERB 33 on CRT)
- 6.2.7.2.6 Start analog recorders.
- 6.2.7.2.7 Verify that IG Servo Error Quadrature (CG 2108) is 0.0±1.2 VRMS. Observe measurement CG 2112, IG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.
- 6.2.7.2.8 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.
- VERB 40, NOUN 20, press ENTER
 - VERB 41, NOUN 20, press ENTER
 - +00000, press ENTER
 - +00000, press ENTER
 - +00000, press ENTER
- 6.2.7.2.9 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 30 seconds before proceeding.
- 6.2.7.2.10 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (~360° IG torquing):
- VERB 24 NOUN 01 ENTER
 - 00407, ENTER
 - 37777, ENTER
 - 37743, ENTER
- Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.
- 6.2.7.2.11 Enter the following sequence into K-Start:
- VERB 42, press ENTER
 - VERB 33, press ENTER (Verify VERB 33 on CRT).
- 6.2.7.2.12 Start analog recorders.
- 6.2.7.2.13 Observe measurement CG 2112, IG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.
- 6.2.7.2.14 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.
- VERB 40, NOUN 20, press ENTER
 - VERB 41, NOUN 20, press ENTER
 - +00000, press ENTER
 - +00000, press ENTER
 - +00000, press ENTER
- 6.2.7.2.15 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 30 seconds before proceeding.

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6.2.7.3 Outer Gimbal Friction Test

6.2.7.3.1 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

- a. CG 2180 OG TORQUE MOTOR CURRENT
- b. CG 2177 OGA SERVO ERROR IN PHASE
- c. CG 2172 OG LX RESOLVER OUTPUT SIN
- d. CG 2173 OG LX RESOLVER OUTPUT COS
- e. CG 2280 OGA CDU FINE ERROR
- f. CG 2281 OGA CDU Coarse Error

6.2.7.3.2 Enter the following sequence into the K-Start. Pushing the ENTER pushbutton after each entry (+360° OG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00405, ENTER
- c. 40000, ENTER
- d. 40034, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.3.3 Enter the following sequence into K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.3.4 Start analog recorders

6.2.7.3.5 Observe measurement CG 2172, OG LX Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.

6.2.7.3.6 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 40, NOUN 20, press ENTER
- b. VERB 41, NOUN 20, press ENTER
- c. +00000, press ENTER
- d. +00000, press ENTER
- e. +00000, press ENTER

6.2.7.3.7 Verify that OG Servo Error Quadrature (CG-2166) is $0.9 \pm 1.2V-RMS$. Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 30 seconds before proceeding.

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6.2.7.3.8 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (=360° OG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00405, ENTER
- c. 37777, ENTER
- d. 37743, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.3.9 Enter the following sequence into K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (verify VERB 33 on CRT).

6.2.7.3.10 Start analog recorders.

6.2.7.3.11 Observe measurement CG 2172, OG 1X resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorder.

6.2.7.3.12 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 40, NOUN 20, press ENTER
- b. VERB 41, NOUN 20, press ENTER
- c. +00000, press ENTER
- d. +00000, press ENTER
- e. -06750, press ENTER

6.2.7.3.13 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = -06750, Wait 30 seconds before proceeding.

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6.2.7.4 Middle Gimbal Friction Test

6.2.7.4.1 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

- a. CG 2150 MG TORQUE MOTOR CURRENT
- b. CG 2147 MGA SERVO ERROR IN PHASE
- c. CG 2142 MG LX RESOLVER OUTPUT SIN
- d. CG 2143 MG LX RESOLVER OUTPUT COS
- e. CG 2250 MGA CDU FINE ERROR
- f. CG 2251 MGA CDU Coarse Error

6.2.7.4.2 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (+135° MG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00411, ENTER
- c. 63777, ENTER
- d. 77777, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.4.3 Enter the following sequence in the K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.4.4 Start the analog recorder.

6.2.7.4.5 Verify that MG Servo Error Quadrature (CG 2138) is 0.0 ± 1.2 VRMS. Observe measurement CG 2142, MG LX Resolver output SIN, on the analog recorder. When steady-state condition occurs (approximately 5 minutes), stop the recorders.

6.2.7.4.6 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 40 NOUN 01, ENTER
- b. VERB 41 NOUN 20, press ENTER
- c. +00000, press ENTER
- d. +00000, press ENTER
- e. +06750, press ENTER

6.2.7.4.8 Enter the following sequence into the K-Start. Push ENTER pushbutton after each entry (-135° MG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00411, ENTER
- c. 14000, ENTER
- d. 00000, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

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6.2.7.4.9 Enter the following sequence in the K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.4.10 Start analog recorders.

6.2.7.4.11 Observe measurement CG 2142, MG 1X Resolver output SIN, on the analog recorder. When the steady-state condition occurs (with the (approximately 5 minutes), stop the recorders., stop the recorder.

6.2.7.4.12 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 36, ENTER
- b. VERB 40 NOUN 20, press ENTER
- c. VERB 41 NOUN 20, press ENTER
- d. +00000, press ENTER
- e. +00000, press ENTER
- f. +00000, press ENTER

6.2.7.5 Examine the traces of the recorded measurements for all six phases of this test to detect any sharp discontinuities. Disregard transients of 0.5 second duration or less on the Gimbal Torque motor current traces, and those less than 0.2 second on the CDU fine error measurement traces. The Gimbal Torque motor currents shall not exceed 0.125 ampere. The CDU Fine Error measurements shall not exceed ± 70 mvrms. The CDU Coarse Error measurement shall not exceed ± 80 mv rms.

The following traces are to be examined: all channels of the G&N system.

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6.2.8 G&N Panel Brightness and Lamp Test

6.2.8.1 Proceed with this test if 6.2.5.2 or 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 before proceeding with this test.

6.2.8.2 Rotate the RETICLE BRIGHTNESS thumbwheel on the Control Indicator Panel and verify the capability to control the illumination of the following lamps:

- a. SCT reticles
- b. SXT reticles
- c. Telescope Panel Angle Counters

6.2.8.3 Turn on LIGHTS-INTEGRAL control on Left Hand Circuit Breaker panel and LEB Lighting Control Panel.

6.2.8.4 Adjust the brightness controls on the LEB Lighting Control Panel and Left Hand Circuit Breaker Panel from minimum brightness to maximum brightness. Verify the operation of the G&N Indicator Control Panel lamps.

6.2.8.4.1 Re-adjust brightness controls for minimum acceptable lighting. Turn off LIGHTS-INTEGRAL control on Left Hand Circuit Breaker panel and LEB Lighting Control Panel.

6.2.8.5 Push and hold the CONDITION LAMPS switch on the G&N Indicator Control Panel to TEST. Verify the illumination of the following lamps:

- a. STAR ACQ
- b. MASTER ALARM lamp

6.2.8.6 Set the CONDITION LAMPS switch to ON. Lamps a and b in 6.2.8.5... shall extinguish.

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- 6.2.9 **Semi-Automatic Moding Check** (Item 6.2.5.3) If the indication on the CRT is "NO ATT" after approximately 100 seconds, perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.9.1 **Perform Master Initialization 6.2.5.3 before proceeding.**
- 6.2.9.1.1 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG1530) is +28.0±3.0 VDC. Record the indication on the CRT. Verify that OPTX 28V 800 cps 1% Oph (CG1211) and OPTX 28V 800 cps 5%-80 ph (CG 1212) are not flashing on the CRT.
- 6.2.9.1.2 Enter VERB 67 into K148. Press the ENTER pushbutton.
- 6.2.9.1.3 Enter 00010 into K148. Press the ENTER pushbutton.
- 6.2.9.1.4 Observe VERB 06 NOUN 01 flashes on the CRT and the PROGRAM display indicates 07.
- 6.2.9.2 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 30 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 02 flashing
 - b. $R1 = +00000 \pm 00007$
 - c. $R2 = +00000 \pm 00007$
 - d. $R3 = +00000 \pm 00007$
 - e. IG angle = 000 ± 1 deg.
 - f. MG angle = 000 ± 1 deg.
 - g. OG angle = 000 ± 1 deg.
- 6.2.9.3 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 03 flashing
 - b. $R1 = +04500 \pm 00007$
 - c. $R2 = +04500 \pm 00007$
 - d. $R3 = +04500 \pm 00007$
 - e. IG angle = 045 ± 1 deg.
 - f. MG angle = 045 ± 1 deg.
 - g. OG angle = 045 ± 1 deg.
- 6.2.9.4 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall extinguish. After approximately 100 seconds the following data shall be displayed on the CRT.
- a. VERB 05 NOUN 30 flashing
 - b. $R1 = 00000 \pm 00003$
 - c. $R2 = 00000 \pm 00003$
 - d. $R3 = 00000 \pm 00003$

NOTE: Negative numbers will be displayed in octal complement form, i.e., -00001 = 77776.

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- 6.2.9.5 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 20 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 05 flashing
 - b. R1 = +07100±00007
 - c. R2 = +07100±00007
 - d. R3 = +07100±00007
 - e. IG angle = 071±1 deg.
 - f. MG angle = 071±1 deg.
 - g. OG angle = 071±1 deg.
- The GIMBAL LOCK lamps on the DSKY's shall light. The PGNS caution lamp on the Indicator Control Panel shall light.
- 6.2.9.6 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 06 flashing
 - b. R1 = +09000±00007
 - c. R2 = +09000±00007
 - d. R3 = +09000±00007
 - e. IG angle = 090±1 deg.
 - f. MG angle = 090±1 deg.
 - g. OG angle = 090±1 deg.
- 6.2.9.7 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 07
 - b. R1 = +13500±00007
 - c. R2 = +13500±00007
 - d. R3 = +13500±00007
 - e. IG angle = 135±1 deg.
 - f. MG angle = 135±1 deg.
 - g. OG angle = 135±1 deg.
- 6.2.9.8 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds VERB 06 NOUN 10 shall flash. The GIMBAL LOCK lamp shall extinguish on the DSKY's. The PGNS caution lamp on the Indicator Control Panel shall extinguish. The gimbal angles shall be approximately 135°, 135°, and 45° respectively.
- 6.2.9.9 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall extinguish. After approximately 100 seconds the following data shall be displayed on the CRT.
- a. VERB 05 NOUN 30 flashing
 - b. R1 = 00000±00003
 - c. R2 = 00000±00003
 - d. R3 = 00000±00003

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6.2.9.10 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 12 flashing
- b. R1 = +22500 ± 00007
- c. R2 = +22500 ± 00007
- d. R3 = +22500 ± 00007
- e. IG angle = 225 ± 1 deg.
- f. MG angle = 225 ± 1 deg.
- g. OG angle = 225 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY's shall light. The PGNS caution lamp on the Indicator Control Panel shall light.

6.2.9.11 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 13 flashing
- b. R1 = +22500 ± 00007
- c. R2 = +22500 ± 00007
- d. R3 = +31500 ± 00007
- e. IG angle = 225 ± 1 deg.
- f. OG angle = 225 ± 1 deg.
- g. MG angle = 315 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY shall extinguish. The PGNS caution lamp on the Indicator Control Panel shall extinguish.

6.2.9.12 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall extinguish. After approximately 100 seconds the following data shall be displayed on the CRT.

- a. VERB 05 NOUN 30 flashing
- b. R1 = 00000 ± 00003
- c. R2 = 00000 ± 00003
- d. R3 = 00000 ± 00003

6.2.9.13 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 15 flashing
- b. R1 = +31500 ± 00007
- c. R2 = +31500 ± 00007
- d. R3 = +31500 ± 00007
- e. IG angle = 315 ± 1 deg.
- f. MG angle = 315 ± 1 deg.
- g. OG angle = 315 ± 1 deg.

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- 6.2.9.14 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall extinguish. After approximately 100 seconds the following data shall be displayed on the CRT.
- VERB 05 NOUN 30 flashing
 - R1 = 00000 ± 00003
 - R2 = 00000 ± 00003
 - R3 = 00000 ± 00003
- 6.2.9.15 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 20 seconds the following data shall be displayed on the CRT.
- VERB 06 NOUN 17 flashing
 - R1 = +28900 ± 00007
 - R2 = +28900 ± 00007
 - R3 = +28900 ± 00007
 - IG angle = 315 ± 1 deg.
 - OG angle = 315 ± 1 deg.
 - MG angle = 289 ± 1 deg.
- The GIMBAL LOCK lamp on the DSKY's shall light. The PGNS caution lamp on the Indicator Control Panel shall light.
- 6.2.9.16 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data will be displayed on the CRT.
- VERB 06 NOUN 20 flashing
 - R1 = +00000 ± 00007
 - R2 = +00000 ± 00007
 - R3 = +00000 ± 00007
 - IG angle = 000 ± 1 deg.
 - MG angle = 000 ± 1 deg.
 - OG angle = 000 ± 1 deg.
- The GIMBAL LOCK lamp on the DSKY's shall extinguish. The PGNS caution lamp on the Indicator Control Panel shall extinguish.
- 6.2.9.17 Enter VERB 33 and press the ENTER pushbutton. The COMP ACTY lamp on the DSKY's shall flash for a few seconds. After approximately 15 seconds the following data shall be displayed on the CRT.
- VERB 06 NOUN 66 flashing
 - R1 = 000xx
 - R2 = xxxxx
- The GIMBAL LOCK lamp on the DSKY's shall light. The PGNS caution lamp on the Indicator Control Panel shall light.
- Record R1 and R2 as the Middle Gimbal CDU drive rate.
MG rate = $\frac{R1}{R2}$ /sec. The Middle Gimbal CDU drive rate shall be 14 ± 2°/sec.

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- 6.2.9.18 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 66 flashing
 - b. R1 = 000xx
 - c. R2 = xxxxx
- The GIMBAL LOCK lamp on the DSKY's shall extinguish. The PGNS caution lamp on the Indicator Control Panel shall extinguish.
- Record R1 and R2 as the Inner Gimbal CDU drive rate.
IG rate = $\frac{R1}{R2}$ °/sec. The Inner Gimbal CDU drive rate shall be 14 ± 2 °/sec.
- 6.2.9.19 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 66 flashing
 - b. R1 = 000xx
 - c. R2 = xxxxx
- Record R1 and R2 as the Outer Gimbal CDU drive rate. OG rate = $\frac{R1}{R2}$ °/sec. The Outer Gimbal CDU drive rate shall be 14 ± 2 °/sec.
- 6.2.9.20 Enter VERB 33 into K148. The NO ATT lamp on the DSKY's shall extinguish. Press the ENTER pushbutton. After approximately 20 seconds VERB 21 NOUN 22 shall flash on the CRT. Enter +00100 into K148 three times. Press the ENTER pushbutton after each entry. The NO ATT lamp on the DSKY's shall momentarily light, then extinguish. After approximately 100 seconds VERB 01 NOUN 10 flashing shall be displayed on the CRT. Press the ENTER pushbutton.
- Enter 00030 into K148. Press the ENTER pushbutton. Verify R1 = 33xxx.
- The ISS WARNING Lamp on the Indicator Control Panel shall light.
The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be ON.
- 6.2.9.21 Enter VERB 33 into K148. Press the ENTER pushbutton. ISS WARNING and ISS CDU FAIL shall be OFF. After approximately 20 seconds VERB 21 NOUN 22 shall flash on the CRT. Enter +03375 into K148 three times. Press the ENTER pushbutton after each entry. The NO ATT lamp on the DSKY's shall momentarily light, then extinguish. After approximately 100 seconds VERB 01 NOUN 10 flashing shall be displayed on the CRT. Press the ENTER pushbutton.
- Enter 00030 into K148. Press the ENTER pushbutton.
Verify R1 = 33xxx.
- The ISS WARNING lamp on the Indicator Control Panel shall light.
The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be ON.

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- 6.2.9.22 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 20 seconds VERB 06 NOUN 66 shall flash on the CRT. The ISS WARNING lamp on the Control Indicator Panel shall extinguish. The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be OFF.
- 6.2.9.23 Set the OPTICS MODE switch on the Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to CMC.
- 6.2.9.24 Enter VERB 33 into K-148 and press the ENTER pushbutton. After approximately 25 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 66 flashing
 - b. R1 = 000xx
 - c. R2 = xxxxx
- Record R1 and R2 as the Shaft Optics CDU drive rate.
Shaft rate = $\frac{R1}{R2}$. The Shaft Optics CDU drive rate shall be $7.32 \pm 1.82^\circ/\text{sec}$.
- 6.2.9.25 Enter VERB 33 into K148. Press the ENTER pushbutton. In about 15 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 66
 - b. R1 = 0000x
 - c. R2 = xxxxx
- Record R1 and R2 as the Trunnion Optics CDU drive rate. Trunnion rate = $\frac{R1}{R2}$. The Trunnion Optics CDU drive rate shall be $1.83 \pm 0.50^\circ/\text{sec}$.
- 6.2.9.26 Terminate the Semi-Automatic Moding Check by entering VERB 34 into K148. Observe PROG display on DSKY's is 00. Press the ENTER pushbutton. Set the G&N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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6.2.10 Zero Optics Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2 Turn On procedure before proceeding.

- 6.2.10.1 Set the G/N POWER - OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $+28.0 \pm 3.0$ VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.
- 6.2.10.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.
 - a. VERB 41, NOUN 20. ENTER
 - b. +00000, ENTER
 - c. +00000, ENTER
 - d. +00000, ENTER
- 6.2.10.3 Insure that the following switches on the G&N Indicator Control Panel are set as follows:
 - a. TELESCOPE TRUNNION to SLAVE TO SXT
 - b. CONTROLLER COUPLING to DIRECT
 - c. CONTROLLER SPEED to HI
- 6.2.10.4 Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K148. Press the ENTER pushbutton.
- 6.2.10.5 Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following on R1 and R2 of the DSKY.
 - a. $R1 = +0.00^\circ \pm 0.08^\circ, -0.03^\circ$ (Shaft Angle)
 - b. $R2 = +0.000^\circ \pm 0.006^\circ, -0.007^\circ$ (Trunnion Los Angle)
 Return the OPTICS MODE switch to MAN.
- 6.2.10.6 Set up the Analog Recorder to monitor the following measurements. Use a chart speed of 10 mm/sec.
 - a. CG 3140 SXT Shaft Tach Output
 - b. CG 3150 SXT Trunnion Shaft Tach Output
 - c. CG 3160 SCT Shaft Tach Output
 - d. CG 3170 SCT Trunnion Tach Output
 - e. CG 3117 SXT Shaft Servo Error in phase
 - f. CG 3118 SXT Trunnion Servo Error in phase
 - g. CG 3145 SXT Shaft MTR control winding
 - h. CG 3155 SXT Trunnion MTR control winding

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- 6.2.10.7 Push the Optics Hand Controller to the right, driving the SXT Shaft until R1 on the DSKY indicate $+180 \pm 1^\circ$. Push the Optics Hand Controller up, driving the SXT Trunnion until R2 on the DSKY indicates $+75 \pm 1^\circ$.
- 6.2.10.8 Start the Analog Recorders and set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.
- 6.2.10.9 Monitor the Analog Recorders until all signals return to null. Stop the Analog Recorders. The elapsed time between the initial and final SXT Tach output null shall be less than 15 seconds. The peak magnitude of the SXT Shaft (CG 3140) and Trunnion (CG 3150) tach outputs shall be -3.3 ± 1.3 VRMS. The peak magnitude of the SCT Shaft Tach Output (CG 3160) shall be 3.3 ± 1.3 VRMS. The peak magnitude of the SCT Trunnion Tach Output (CG 3170) shall be 0.85 ± 0.35 VRMS. The SXT SHAFT (CG 3117) and TRUNNION (CG 3118) Servo Error in PHASE measurements shall each have a maximum magnitude of 2 VRMS. The peak magnitude of the SXT SHAFT (CG 3145) and TRUNNION (CG 3155) MTR Control Winding measurements shall be 0.85 ± 0.35 VRMS.
- 6.2.10.10 Record R1 and R2 on the CRT. The data displayed shall be as follows:
- a. R1 = 000.00±000.03
 - b. R2 = 00.000±00.006
- Enter VERB 34 and press the ENTER pushbutton.
- 6.2.10.11 Record the Telescope Panel Angle Counter indications. The Shaft Angle shall be 0.0 ± 0.11 degrees. The Trunnion Angle shall be 0.0 ± 0.22 degrees.
- 6.2.10.12 Set the OPTICS MODE switch on the G&N Indicator Control Panel to MAN. Set the G/N Power Optics switch on the LEB Lighting Control Panel to OFF.
- 6.2.10.13 Insert the universal tool or equivalent into the Trunnion Tool input and engage drive mechanism (button out). Verify that the trunnion turns by viewing the movement through the SCT eyepiece while turning the tool until the TPAC reads $+5^\circ$. Remove the tool from the trunnion tool input.
- 6.2.10.14 Insert the Universal Tool or equivalent into the Shaft Tool input and engage the drive mechanism (button out). Verify that the Shaft turns by viewing the movement through the SCT eyepiece while turning the tool so that the shaft moves through an angle from 0° to $+3^\circ$ to -3° to 0 as indicated on the shaft TPAC. Disengage the shaft drive mechanism (button in) and remove the tool.
- 6.2.10.15 Insert the Universal Tool or equivalent into the Trunnion Tool input. Verify that the Trunnion Turns by viewing the movement through the SCT eyepiece while turning the tool so that the trunnion moves from $+5^\circ$ to -5° and back to zero as indicated on the Trunnion TPAC. Disengage the trunnion drive mechanism (button in) and remove the tool.

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6.2.11 OPTICS Coordinate Transformation Control Test

NOTE: Proceed with this test if 6.2.3 Operate Power on Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding.

6.2.11.1 Set/verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.11.2 Enter the following into the K-Start. Press the ENTER pushbutton after each entry:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.11.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the position indicated.

- a. TELESCOPE TRUNNION to SLAVE TO SXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to HI

6.2.11.4 Set up the analog recorders to monitor the following measurements:

- a. CG 3160 SCT Shaft Tachometer Output
- b. CG 3170 SCT Trunnion Tachometer Output

6.2.11.5 Enter the following into the K-Start to monitor the OPTICS CDU's:

VERB 16 NOUN 55, press ENTER

6.2.11.6 Set the OPTICS MODE switch on the G&N Panel to ZERO. Wait 15 seconds. Return the OPTICS MODE switch to MAN.

6.2.11.7 Using the OPTICS CONTROL STICK, drive the Optics until R1 = +225.00 and R2 = +10.000 on the CRT and the DSKY's.

6.2.11.8 Set the CONTROLLER COUPLING switch on the G&N Panel to RSLV and controller speed switch to MED.

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- 6.2.11.9 Position the movable optics target such that it is centered on the SCT retical pattern, then start the analog recorders at a chart speed of 10 mm/second.
- 6.2.11.10 Quickly displace the OPTICS CONTROL STICK 45 ± 10 degrees in the upper right hand quadrant while sighting on the optics target through the SCT eyepiece. The target shall appear to move in the upper right field of view of the SCT at 45 ± 10 deg. When Target leaves the SCT upper right field of view press MARK pushbutton and immediately record the shaft angle as displayed on R1 of the DSKY. The recorded shaft angle shall be $+225 \pm 10/00$ degrees.
- 6.2.11.11 Enter VERB 34 in the DSKY.
Press the ENTER pushbutton.
- 6.2.11.12 Stop the analog recorder and measure the elapsed time between the initial and the final signal null conditions for the two measurements. The elapsed time shall be 24 ± 6 seconds.
- 6.2.11.13 Set the CONTROLLER COUPLING switch on the G&N Panel to Direct.
Set the OPTICS MODE switch to ZERO. After 15 seconds, return the switch to MAN. *See Note 1 on the G&N Panel for details on the OPTICS MODE switch.*
Set the OPTICS MODE switch to ZERO. After 15 seconds, return the switch to MAN.
NOTE: If Optics testing will not continue, set the G/N POWER OPTICS switch on the LEB Lighting Control Panel to OFF. *See Note 2 on the LEB Panel for details.*

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6.2.12

Optics Positional Accuracy Test. Proceed with this test if 6.2.3 Operate Power On Test, or 6.2.5.2, Turn-On Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2, Turn On Procedure, before proceeding.

NOTE: This test requires the use of the G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT StLOS before proceeding. Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.

6.2.12.1

Set/verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Set Tracker switch to OFF. Verify the following:

- +28 VDC OPTX OPERATE BUS (CG 1530) is 28.8 ± 3 VDC. Record the indication on the CRT.
- CG 1211 OPTX 28V 800 cps 1% 0 ph not flashing on CRT.
- CG 1212 OPTX 800 cps 5% - 90 ph not flashing on CRT.

6.2.12.2

Enter the following sequence into the K-Start.

- VERB 41, NOUN 20, ENTER
- +00000, ENTER
- +00000, ENTER
- +00000, ENTER

6.2.12.3

Insure that OPTICS Optics control switches on the G&N Indicator Control Panel are set as follows:

- OPTICS MODE TO MAN
- CONTROLLER SPEED to LO
- CONTROLLER COUPLING to DIRECT
- TELESCOPE TRUNNION to SLAVE TO SXT

6.2.12.4

Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN.

6.2.12.5

Resolution Checks

6.2.12.5.1

Sight through the SXT eyepiece. Using the OPTIC CONTROL STICK, adjust the SXT to obtain the best reflected field of view of the 5-inch autocollimator reticle engravings at the center of the field of view.

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- 6.2.12.5.2 Note that the autocollimator reticle contains a series of lines of different thickness and width. Each set of lines is marked with a number (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines. The SXT resolution shall be at least 10 arc-seconds at the center of the field of view.
- 6.2.12.5.3 Repeat 6.2.12.5.1 and 6.2.12.5.2 using the SCT and the SCT resolution chart. The SCT shall have a resolution of at least 3 arc-minutes at the center of the field of view.
- 6.2.12.6 Slave Telescope Mode Checks
- 6.2.12.6.1 Enter VERB 16 NOUN 55 into the K-Start, Press the ENTER pushbutton.
- 6.2.12.6.2 Set the OPTICS MODE switch on the Control Indicator Panel to ZERO. Wait 15 seconds.
- 6.2.12.6.3 Record the SCT Shaft and Trunnion angles as indicated by the TPAC and the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between the TPAC Shaft angle and the Shaft CDU angle shall be $\pm 0.11^\circ$ or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be $\pm 0.22^\circ$ or less.
- 6.2.12.6.4 Place the OPTICS MODE switch to MAN. Using the OPTICS CONTROL STICK and CONTROLLER SPEED switch, drive the SXT Shaft and Trunnion CDU's until $R1 = +035.00 \pm 0.10$ deg. and $R2 = +35.000 \pm 0.100$ deg. Record R1 and R2. Record the Shaft and Trunnion angles as indicated by the TPAC. The difference between the TPAC Shaft angle and Shaft CDU angle shall be $\pm 0.11^\circ$ or less. The difference between the TPAC Trunnion angle and Trunnion CDU angle shall be $\pm 0.22^\circ$ or less.
- 6.2.12.6.5 Set the OPTICS MODE switch to ZERO.
- 6.2.12.6.6 Set the TELESCOPE TRUNNION switch to the 0° position.
- 6.2.12.6.7 Remove the plug from the base of the SXT eyepiece and install the Adapter Assembly and Portable Light Assembly. Turn on the light.
- NOTE: If needed to reduce external light, place a photographers hood over the optics head and retroreflecting prism.

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- 6.2.12.6.8 Sight through the SCT eyepiece and provide direction to personnel outside spacecraft for positioning the Retroreflecting Prism, Model No. A23-200, to span between the SXT LLOS and SCT LOS such that the illumination from the back-light filament is clearly visible at the center of the field of view. Prism must be held in this alignment position until completion of Step 6.2.12.6.11.
- 6.2.12.6.9 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Note the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement, expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. For instance, the outer ends of the SXT reticle lines are 6% from center. Displacement shall be less than 50% (bar must be closer to center than to edge of field of view).
- 6.2.12.6.10 Set the TELESCOPE TRUNNION switch to SLAVE to SXT.
- 6.2.12.6.11 Again direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in Step 6.2.12.6.9. Note the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement, expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. Displacement shall be less than 50%.
- 6.2.12.6.12 Remove the Retroreflecting Prism.
- 6.2.12.6.13 Replace the Portable Light in the adapter on the SXT eyepiece.
- 6.2.12.6.14 While sighting into the SCT eyepiece, set the TELESCOPE TRUNNION switch to 25° and observe that the resolution pattern mounted outside the spacecraft appears to move downward from the center of the field of view to the zero reticle marking that is 25° below the center of the field of view.
- 6.2.12.6.15 Record the TPAC Trunnion Angle. It shall be $25.00^\circ \pm .22^\circ$.
- 6.2.12.6.16 Set the TELESCOPE TRUNNION switch to SLAVE TO SXT. Set the OPTICS MODE switch to MAN.
- 6.2.12.7 SXT Parallelism Tests
- 6.2.12.7.1 Using the OPTICS CONTROL STICK drive the SXT StLOS Trunnion to $+15.000^\circ \pm 2^\circ$ as indicated in R2 of the DSKY. Maintain a Shaft CDU angle of 000.00 ± 0.10 degrees as indicated by R1 on the DSKY.
- 6.2.12.7.2 Sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to superimpose the SXT LLOS horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.

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- 6.2.12.7.3 Repeat 6.2.12.7.2 twice. Calculate and record the average of the three autocollimator readings.
- 6.2.12.7.4 Set the OPTICS MODE switch to ZERO.
- 6.2.12.7.5 Again sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to bring the SXT StLOS horizontal reticle and autocollimator horizontal filar images to coincide. Record the autocollimator reading.
- 6.2.12.7.6 Repeat 6.2.12.7.5 twice. Calculate and record the average of the three autocollimator readings. The average value obtained here shall not differ from that obtained in 6.2.12.7.3 by more than 10 arc seconds.
- 6.2.12.7.7 Set the OPTICS MODE switch to MAN. Using the OPTICS CONTROL STICK drive the SXT Trunnion angle to $85.000^{\circ} \pm 5^{\circ}$ as indicated on R2 of the DSKY. Set the CONTROLLER SPEED to LO and drive the SXT Trunnion to $+90.000^{\circ} \pm 0.100^{\circ}$ as indicated on R2 of the DSKY. Insure that the SXT Shaft angle remains at 000.00 ± 0.10 degrees as indicated by R1 on the DSKY.
- 6.2.12.7.8 Sight through the SXT. Two reticle patterns shall be visible. Use the OPTICS CONTROL STICK to adjust the SXT Trunnion angle until the two horizontal reticle lines are coincident. Record the Trunnion CDU angle displayed in R2. The Trunnion CDU angle shall be 90.000 ± 0.010 degrees.
- 6.2.12.7.9 Remove the Portable Light Assembly and Adapter Assembly from the base of the SXT eyepiece. Replace the SXT eyepiece plug.
- NOTE: If Optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.
- 6.2.12.8 Shaft and Trunnion Positional Accuracy Checks.
- 6.2.12.8.1 Set the OPTICS MODE switch to ZERO. After 15 seconds, return the selector to MANUAL.
- 6.2.12.8.2 Sight through the SXT. Using the control stick align the SXT SLOS with optical target No. 1 on the G&N Installation Fixture Model No. A23-097.
- 6.2.12.8.3 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton. Record the value of R1 and R2 displayed on the CRT. Record the Shaft and Trunnion Angles from the TPAC.

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- 6.2.12.8.4 Sight through the SXT. Using the control stick align the SXT SLOS with Optical Target No. 2 on A23-097.
- 6.2.12.8.5 Record the value in R1 and R2 on the CRT. Record the Shaft and Trunnion Angles from the TPAC.
- 6.2.12.8.6 Set the OPTICS MODE switch to ZERO. After 15 seconds set the switch to CMC.
- 6.2.12.8.7 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.8 Enter the value recorded from R1 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.9 Enter the value recorded from R2 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.10 Sight through the SXT. The SLOS should be centered on Optical Target No. 1 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.3 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.11 Enter VERB 41 NOUN 55 into the K-START. Press the ENTER pushbutton.
- 6.2.12.8.12 Enter the value recorded from R1 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.13 Enter the value recorded from R2 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.14 Sight through the SXT. The SLOS should be centered on Optical Target No. 2 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.5 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.15 Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MANUAL.
- 6.2.12.8.16 Enter VERB 41 NOUN 20 into the K-START. Press the ENTER pushbutton. Enter +00000 into the K-START 3 times. Press the ENTER pushbutton after each entry.

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- Optics Slew Rate Test
- 6.2.13** **Optics Slew Rate Test.** Enter the following sequence into the G&N Indicator Control Panel to perform the test. **NOTE: Perform Master Initialization 6.2.5.3 before proceeding.**
- 6.2.13.1** Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $+28.0 \pm 3.0$ VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT. Set Tracker switch to OFF.
- 6.2.13.2** Enter the following sequence into K148. Press the ENTER pushbutton after each entry.
- VERB 41 NOUN 20, ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER
- 6.2.13.3** Verify and/or set the following switches on the G&N Indicator Control Panel to the positions indicated.
- TELESCOPE TRUNNION to SLAVE to SXT
 - CONTROLLER COUPLING to DIRECT
 - CONTROLLER SPEED to HI
- 6.2.13.4** Monitor the OCDU's by entering VERB 16 NOUN 55 into K148. Press the ENTER pushbutton.
- 6.2.13.5** Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. **NOTE: The following sequence is performed to ensure the trunnion slew rate is displayed on the CRT.**
- Set the OPTICS MODE switch to ZERO.
 - Set the OPTICS MODE switch to MAN.
- Set the OPTICS MODE switch on the G&N Indicator Panel to MAN.
- NOTE:** Read & understand step 6.2.13.6 before proceeding. Do not hold Control Stick at upper limit more than 10 seconds, or exceed a trunnion angle of 85°
- Trunnion Slew Rate - HI Speed
- 6.2.13.6** Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R2 and R3. The data displayed is in the following form:
- R2 = $\pm XX.XXX$ (Trunnion LOS angle in deg.)
 - R3 = $+XXX.XX$ (Time in seconds)

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6.2.13.7 Perform the following calculations:

NOTE: In performing calculation b. below, and in similar calculations throughout this test procedure, the following shall be noted and taken into account. It is possible that the second R3 reading may be smaller than the first reading. If so, add an overflow time value of 163.84 sec to the second reading and then subtract the first reading, in order to obtain Δ time as the difference of the two R3 readings.

- a. Difference between R2 displays = _____ (Δ trun. angle)
 b. Difference between R3 displays = _____ (Δ time)
 c. $\frac{\Delta \text{ trun. angle}}{\Delta \text{ time}} = \text{---}^\circ \text{---} \text{ deg/sec}$

The Trunnion slew rate shall be 10 ± 2 deg/sec.

Shaft Slew Rate - HI Speed

6.2.13.8 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read and understand step 6.2.13.9 before proceeding. Do not hold Control Stick at right limit for more than 10 seconds, or exceed a shaft angle of 250° .

6.2.13.9 Push and hold the Optics Control stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R1 and R3. The data displayed is in the following form.

R1 = \pm XXX.XX (Shaft angle in deg.)
 R3 = +XXX.XX (Time in seconds)

6.2.13.10 Perform the following calculations

- a. Difference between R1 displays = _____ (Δ shaft angle)
 b. Difference between R3 displays = _____ (Δ time)
 c. $\frac{\Delta \text{ Shaft angle}}{\Delta \text{ time}} = \text{---}^\circ \text{---} \text{ deg/sec}$

The Shaft Slew Rate shall be 19.5 ± 3.9 deg/sec
 Trunnion Slew Rate - MED Speed

6.2.13.11 Set the OPTICS MODE switch to zero. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to MED.

NOTE: Read & understand 6.2.13.12 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

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6.2.13.12 Push and hold the Optics Control stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 10 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R2 & R3. The data displayed is in the following form:

- a. R2 = +XX.XXX (Trunnion LOS Angle in degrees)
- b. R3 = +XXX.XX (Time in seconds)

6.2.13.13 Perform the following calculations:

- a. Difference between R2 displays = ____ . ____ (Δ Trunnion Angle)
- b. Difference between R3 displays = ____ . ____ (Δ Time)

$$\frac{\Delta \text{ Trunnion angle }}{\Delta \text{ Time }} = \text{ ____ deg./sec }$$

The Trunnion slew rate shall be 1.0±0.2 deg/sec.

Shaft Slew Rate - MED Speed

6.2.13.14 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read & understand 6.2.13.15 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.15 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 10 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R1 and R3. The data displayed is in the following form:

- a. R1 = + XXX.XX (Shaft Angle in degrees)
- b. R3 = + XXX.XX (Time in seconds)

6.2.13.16 Perform the following calculations

- a. Difference between R1 displays = ____ . ____ (Δ Shaft Angle)
- b. Difference between R3 displays = ____ . ____ (Δ Time)

$$\frac{\Delta \text{ Shaft Angle }}{\Delta \text{ Time }} = \text{ ____ deg/sec }$$

The Shaft Slew Rate shall be 2.0±0.4 deg/sec.

Trunnion Slew Rate - LO Speed

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- 6.2.13.17 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to LO.

NOTE: Read and understand 6.2.13.18 before proceeding. Do not hold control stick at upper limit for more than 30 seconds.

- 6.2.13.18 Push and hold the Optics Control stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 10 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R2 and R3. The data displayed is in the following form:

- a. R2 = XX.XXX (Trunnion LOS Angle in degrees)
b. R3 = .XXX.XX (Time in seconds)

- 6.2.13.19 Perform the following calculations**

- a. Difference between R2 displays = XX.XXX (Δ Trunnion Angle)
b. Difference between R3 displays = XXX.XX (Δ Time)

c. $\frac{\Delta \text{ Trunnion Angle}}{\Delta \text{ Time}} = \text{--- deg/sec}$

The Trunnion Slew Rate shall be 0.10 ± 0.02 deg/sec.

Shaft Slew Rate - LO Speed

- 6.2.13.20 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read and understand 6.2.13.21 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

- 6.2.13.21 Push and hold the Optics Control stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 10 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R1 and R3. The data displayed is in the following form:

- a. R1 = XXX.XX (Shaft Angle in degrees)
b. R3 = XXX.XX (Time in seconds)

- 6.2.13.22 Perform the following calculations:**

- a. Difference between R1 displays = --- . --- (Δ Shaft Angle)
 b. Difference between R3 displays = --- . --- (Δ Time)

c. $\frac{\Delta \text{ Shaft Angle}}{\Delta \text{ Time}} = \text{---} \cdot \text{---} \text{ deg/sec}$

The Shaft Slew Rate shall be 0.20 ± 0.04 deg/sec.

- 6.2.13.23 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.**

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- 6.2.14 Stabilization Loop Step Response Test
- 6.2.14.1 Proceed with this test if the Operate Power On Test of 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding.
- 6.2.14.2 Insure that the Carry-on Command Stimuli Unit, Model No. C14-200, is installed and connected.
- 6.2.14.3 Enter VERB 36 into K148. Press the ENTER pushbutton, then the ERROR RESET pushbutton.
- 6.2.14.4 Inner Gimbal Response Test
- 6.2.14.4.1 Enter code 2032000000 in C-START Module 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2117 IGA SERVO ERROR on 4A1-A3-CH1.
- 6.2.14.4.2 Enter VERB 41 NOUN 20 into K148. Press ENTER pushbutton.
- 6.2.14.4.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.
- 6.2.14.4.4 Enter VERB 42 into K148. Press ENTER.
- 6.2.14.4.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.
- 6.2.14.4.6 Enter 0001 into R154. Verify and execute to apply +28 VDC ACE ENABLE to the PSAAM.
- 6.2.14.4.7 Enter 1000 into R155. Verify and execute to enter a DC step into the IG stabilization loop.
- CAUTION: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.
- 6.2.14.4.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.
- 6.2.14.4.9 Enter 0000 into 4A2-A6-R155; the top part of switch should be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the IG Stabilization Loop. The bottom part of switch shall be extinguished.
- 6.2.14.4.10 After the transient has died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step input and the settling of the error signal to a value equal to ± 5 percent of the original step amplitude. In addition, record the total number of overshoots.

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- 6.2.14.4.10.1 The inner gimbal stabilization loop response time shall be less than 0.1 second.
- 6.2.14.4.10.2 The maximum number of overshoots on the IGA Servo Error signals shall be three.
- 6.2.14.5 Middle Gimbal Response Test
- 6.2.14.5.1 Enter code 2028000000 into C-START MODULE 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2147 MGA SERVO ERROR on 4A1-A3-CH1.
- 6.2.14.5.2 Enter VERB 41 NOUN 20 into K148. Press ENTER.
- 6.2.14.5.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.
- 6.2.14.5.4 Enter VERB 42 into K148. Press ENTER.
- 6.2.14.5.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.
- 6.2.14.5.6 Enter 0100 into 4A2-A6-R155. The top part of switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.
- 6.2.14.5.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the MG Stabilization Loop.
- CAUTION: If the transient caused by the step input does not die within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.
- 6.2.14.5.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.
- 6.2.14.5.9 Enter 0000 into 4A2-A6-R155. The top part of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press XEQ/SEAL pushbutton to remove the step input to the MG stabilization loop.
- 6.2.14.5.10 After the transients have died out, stop the analog recorder. Record the stab loop response time by measuring the time interval between removing the step input and the settling of the error signals to a value equal to ± 5 percent of the original step amplitude. In addition, record the total number of overshoots.
- 6.2.14.5.10.1 The middle gimbal stabilization loop response time shall be less than 0.1 second.
- 6.2.14.5.10.2 The maximum number of overshoots on the MGA Servo Error signals shall be three.

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6.2.14.6 Outer Gimbal Response Test

- 6.2.14.6.1 Enter code 2026000000 in C-START Module 4A1-A5-C156. Press XEQ/SEAL Pushbutton to call up CG 2177 OGA SERVO ERROR on 4A1-A3-CH1.
- 6.2.14.6.2 Enter VERB 41 MCUN 20 into K148. Press ENTER.
- 6.2.14.6.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.
- 6.2.14.6.4 Enter VERB 42 into K148. Press ENTER pushbutton.
- 6.2.14.6.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.
- 6.2.14.6.6 Enter 0010 into 4A2-A6-R155. The top half of the switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.
- 6.2.14.6.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the OG Stabilization Loops.

NOTE: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.

- 6.2.14.6.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.
- 6.2.14.6.9 Enter 0000 into 4A2-A6-R155. The top half of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-155 are illuminated. Start analog recorder. Press the XEQ/SEAL push-button to remove the step input to the OG Stabilization Loop.
- 6.2.14.6.10 After the transients have died out, step the analog recorder. Record the loop response time by measuring the time interval between removing the step input and the settling of the error signal to a value equal to 25 percent of the original step amplitude. In addition, record the total number of overshoots.
- 6.2.14.6.10.1 The outer gimbal stabilization loop response time shall be less than 0.1 second.
- 6.2.14.6.10.2 The maximum number of overshoots on the OGA Servo Error Signals shall be three.
- 6.2.14.7 Enter VERB 40 NOUN 20 into KL48. Press the ENTER pushbutton.
- 6.2.14.7.1 Enter VERB 41 NOUN 20 into KL48. Press the ENTER pushbutton.

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- 6.2.14.7.2 Enter +00000 into K148. Press the ENTER pushbutton.
- 6.2.14.7.3 Enter +00000 into K148. Press the ENTER pushbutton.
- 6.2.14.7.4 Enter +00000 into K148. Press the ENTER pushbutton.

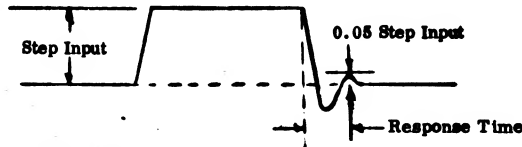


Figure 1: Typical Step Input Response

- 6.2.14.7.5 Enter 0000 into R154. Verify and execute to remove +28 VDC ACE ENABLE.
- 6.2.15 IRIG Scale Factor Test
- 6.2.15.1 Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.15.2 Verify that the IMU OPERATE power has been applied for a minimum of 1 hour, and that at least 1 hour has elapsed since running of the Gimbal Friction Test, 6.2.7.
- 6.2.15.3 Set up the Analog Recorders to monitor the following signals:
- a. CG 2117 IG SERVO ERROR
 - b. CG 2147 MG SERVO ERROR
 - c. CG 2177 OG SERVO ERROR
 - d. CG 2120 IG TM CURRENT
 - e. CG 2150 MG TM CURRENT
 - f. CG 2180 OG TM CURRENT
- 6.2.15.3.1 Start the analog recorder chart drive using a chart speed of 1 mm/sec. The recorder shall run for the duration of 6.2.15.
- 6.2.15.4 Enter VERB 57 into K148. Press the ENTER pushbutton.
- 6.2.15.5 Enter 00005 into K148. Press the ENTER pushbutton. Program 07 shall be displayed.
- 6.2.15.6 VERB 06 NOUN 61 shall flash on CRT and the following displayed in R1 and R2:
- R1 = *XXXXX (some Nav. Base azimuth)
- R2 = *XXXXX (some test site latitude; see Table I)

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- 6.2.15.7 If the values displayed in R1 and R2 are correct, proceed with test, if not perform the following sequence:
- To correct R1, on the K-start enter VERB 21, press ENTER pushbutton, ~~xxx.xx~~, press ENTER (~~xxx.xx~~ is correct nav. base azimuth).
 - To correct R2, on the K-start enter VERB 22, press ENTER pushbutton, ~~xxx.xxx~~, press ENTER (obtain correct site latitude from Table I).
- Verify values in R1 and R2 are correct.

Table I

<u>Site</u>	<u>Latitude</u>
NAA	+33.921
MSC	+29.556
MILA	+28.516

- 6.2.15.8 On K-148 enter the following sequence:
- VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
+00001 ENTR
- NOTE: If PROG lamp changes from 07 to 00 during next step or PROG ALARM is on, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.8.
- 6.2.15.9 In approximately 160 seconds VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (+X IRIG Scale Factor error in part per million, Position +00001).
- 6.2.15.10 On K-148 enter the following sequence:
- VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
+00002 ENTR
- NOTE: If PROG lamp changes from 07 to 00 during next step or PROG ALARM lamp is on, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.7 and 6.2.15.10.
- 6.2.15.11 In approximately 160 seconds VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (+Y IRIG Scale Factor error in parts per million Position +00002).
- 6.2.15.12 On K-148 enter the following sequence:
- VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
+00003 ENTR
- NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM lamp is ON, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.7 and 6.2.15.12.

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- 6.2.15.13 In approximately 200 seconds VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (-Z IRIG Scale Factor error in parts per million, position +00003).
- 6.2.15.14 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
-00001 ENTR
NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM lamp is on, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.7 and 6.2.15.14.
- 6.2.15.15 In approximately 160 seconds, VERB 05 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (-X IRIG Scale Factor error in parts per million, Position -00001).
- 6.2.15.16 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
-00002 ENTR
NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM lamp is ON, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.7 and 6.2.15.16.
- 6.2.15.17 In approximately 160 seconds, VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (-Y IRIG Scale Factor error in parts per million, Position -00002).
- 6.2.15.18 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
-00003 ENTR
NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM is ON, enter VERB 36 ENTR and repeat steps, 6.2.15.4 through 6.2.15.7 and 6.2.15.18.
- 6.2.15.19 In approximately 160 seconds, VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (+Z IRIG Scale Factor error in parts per million, Position -00003).
- 6.2.15.20 Repeat steps 6.2.15.8 through 6.2.15.19 twice to obtain second and third set of data.
- 6.2.15.21 Terminate this test by entering in K-148: VERB 34 ENTR
- 6.2.15.22 The average of the three readings of Scale Factor Error for each of the 6 positions shall be 0 ± 1750 PPM.

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- 6.2.16 IMU Performance Test
- 6.2.16.1 Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.16.2 Enter VERB 01 NOUN 10 into K148. Press the ENTER pushbutton. Enter 00003 into K148. Press the ENTER pushbutton. Record R1 = AAAAA and the time of day.
- 6.2.16.3 Enter VERB 21 NOUN 02 into K148. Press the ENTER pushbutton. Enter 01300 into K148. Press ENTER. Enter AAAAA into K148. Press ENTER.
- 6.2.16.4 Enter VERB 06 NOUN 02 into K148. Press ENTER. Enter 01300 into K148. Press ENTER. Record R1 = BBBB.
- 6.2.16.5 Perform the following calculations:
- $\frac{R1 (BBBB) \times 5.12}{3600} = CCCC.C$ (hrs. in high order scaler channel 3)
 - $23.3 - CCC.C = DDDDD$ Hrs.
 - Add DDDDD to time of day recorded in step 1.
- Do Not enter any of the PIPA scale factor tests within -0.2 hours of the time of day calculated in step 6.2.16.5c. This is the time at which the high order scaler, channel 3, will overflow. If a PIPA scale factor test is being performed at this time, unacceptable test results will occur.
- 6.2.16.6 Verify that the IMU Operate Power has been applied for at least one hour.
- 6.2.16.7 Test Initiation.
- 6.2.16.7.1 Enter the following into K148.
- VERB 01 NOUN 01, ENTER
 - 00362, ENTER
 - Record R1 = XXXXY
- 6.2.16.7.2 Enter the following into K148
- VERB 21 NOUN 01, ENTER
 - 00362, ENTER
 - XXXXY', ENTER where Y' is determined by Table XV and XXXX is that recorded in 6.2.16.7.1.

TABLE XV

Y (from 6.2.16.7.1)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

- 6.2.16.7.3 Enter VERB 57 into K148. Press the ENTER pushbutton.
- 6.2.16.7.4 Enter 00001 into K148. Press the ENTER pushbutton.
- 6.2.16.7.5 On the CRT, DSKY display verify R1 (Navigation Base Azimuth) and R2 (Site Latitude) are correct.

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- 6.2.16.7.6 If values for R1 and R2 are correct, proceed to next step. If values for R1 and R2 are incorrect, enter the following sequence into K-148.

VERB 24 ENTR

+XXX.XX ENTR (Correct navigation base azimuth ± 0.50 deg)

+XX.XXX ENTR (Correct site latitude from Table XX)

Verify values in R1 and R2 are correct

TABLE XX

<u>LOCATION</u>	<u>LATITUDE</u>
NAA	+33.921
MSC	+29.556
MILA	+28.616

- 6.2.16.7.7 On K-148 enter the following sequence:

VERB 33 ENTR

VERB 06 NOUN 66 shall flash

- 6.2.16.7.8 On CRT, DSKY display, verify R1 = +00900 (Time), R2 = +00000 (Test Index No.) and R3 = +00001 (Test Position). If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR

+00900 ENTR (Test Time in Seconds)

+00000 ENTR (Test Index Number)

+00001 ENTR (Test Position Entry)

- 6.2.16.7.9 On K-148 enter the following sequence:

VERB 33 ENTR

- 6.2.16.7.10 In approximately 17 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (+NBDY) Position +00001.

- 6.2.16.7.11 On K-148 enter the following sequence:

VERB 33 ENTR

- 6.2.16.7.12 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT, record R1 and R2 (+X PIPAS) Position +00001. Row 1 is whole part, Row 2 is fractional part, Units are cm/sec.

6.2.16.7.13 On K-148 enter the following sequence:

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6.2.16.7.13 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.2.16.7.14 On CRT DSKY displays, verify R1 = +00900, R2 = +00000, and R3 = +00002.

If values for R1, R2 and R3 are correct, proceed to next step.
If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00002 ENTR (Test Position Entry)

6.2.16.7.15 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.16 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (+NBDZ) Position +00002.

6.2.16.7.17 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.18 In approximately 90 secs. VERB 06 NOUN 66 shall flash. From the CRT, record R1 and R2 (-X PIPAG) Position +00002.

6.2.16.7.19 On K-148 enter the following sequence:

VERB 21 NOUN 01 ENTR
00407 ENTR
77757 ENTR
VERB 21 NOUN 01 ENTR
00411 ENTR
00020 ENTR
VERB 33 ENTR

6.2.16.7.20 In approximately 67 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (-NBDX + ADLAX) Pos +00002, Record CRT CDU gimbal angle indications and time.

6.2.16.7.21 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

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6.2.16.7.22 On CRT, DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00003.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00003 ENTR (Test Position Entry)

6.2.16.7.23 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.24 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (-NBCX) Position +00003.

6.2.16.7.25 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.26 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R1 and R2 (+Z PIPAG) Position +00003.

6.2.16.7.27 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.2.16.7.28 On the CRT, DSKY display verify R1 = +00900, R2 = 00000, and R3 = +00004.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00004 ENTR (Test Position Entry)

6.2.16.7.29 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.30 In approximately 17 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (+NBDY +ADSRAY) Position +00004.

6.2.16.7.31 On K-148 enter the following sequence:

VERB 33 ENTR

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- 6.2.16.7.32 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R1 and R2 (-Z PIPAG) Position +00004.
- 6.2.16.7.33 On K-148 enter the following sequence:
- VERB 21 NOUN 01 ENTR
00405 ENTR
00020 ENTR
VERB 21 NOUN 01 ENTR
00407 ENTR
77757 ENTR
VERB 33 ENTR
- 6.2.16.7.34 In approximately 67 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R2 (+NBDZ + ADIAZ) Position +00004. Record CRT CDU gimbal angle indications and time.
- 6.2.16.7.35 On K-148 enter the following sequence:
- VERB 33 ENTR
VERB 06 NOUN 66 shall flash
- 6.2.16.7.36 From the CRT DSKY display, verify R1 = +00900, R2 = +00000 and R3 = +00005.
- If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:
- VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00005 ENTR (Test Position Entry)
- 6.2.16.7.37 On K-148 enter the following sequence:
- VERB 33 ENTR
- 6.2.16.7.38 The PROG alarm and GIMBAL LOCK lamps shall light. Press Error Reset. The PROG alarm lamp shall extinguish.
- 6.2.16.7.39 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R1 and R2 (+Y PIPAG) Position +00005.
- 6.2.16.7.40 On K-148 enter the following sequence:
- VERB 34 ENTR
VERB 06 NOUN 66 shall flash

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VERB 04 ENTR
VERB 06 NOUN 66 shall flash

- 6.2.16.7.41 On the CRT DSKY display, verify R1 = +00900, R2 = +00000 and R3 = +00006.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2, and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00006 ENTR (Test Position Entry)

- 6.2.16.7.42 On K-148 enter the following sequence:

VERB 33 ENTR

- 6.2.16.7.43 The PROG alarm and GIMBAL LOCK lamps shall light. Press Error Reset. The PROG alarm lamp shall extinguish.

- 6.2.16.7.44 In approximately 90 secs VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R1 and R2. (-Y PIPAG) Position +00006.

- 6.2.16.7.45 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

- 6.2.16.7.46 On the CRT DSKY display, verify R1 = +00900, R2 = +00000 and R3 = +00007.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2, and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00007 ENTR (Test Position Entry)

- 6.2.16.7.47 On K-148 enter the following sequence:

VERB 33 ENTR

- 6.2.16.7.48 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (+.707 ADSRAX-NBDX) Position +00007.

- 6.2.16.7.49 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

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6.2.16.7.50 On the CRT DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00008.

6.2.16.7.51 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.52 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 [-.707 (NBDZ+NBDY) +0.5 (ADIAZ-ADIA Y) +0.5 (ADSRAY + ADSRAZ)] Position +00008.

6.2.16.7.53 On K-148 enter the following:

VERB 34 ENTR

VERB 06 NOUN 66 shall flash

6.2.16.7.54 On the CRT DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00009.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR

+00900 ENTR (Test Time in Seconds)

+00000 ENTR (Test Index Number)

+00009 ENTR (Test Position Entry)

6.2.16.7.55 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.56 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (-NBDZ +.707 ADSRAZ) Position +00009.

6.2.16.7.57 On K-148 enter the following sequence:

VERB 34 ENTR

VERB 06 NOUN 66 shall flash

6.2.16.7.58 On the CRT DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00010.

If values for R1, R2, and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR

+00900 ENTR (Test Time in Seconds)

+00000 ENTR (Test Index Number)

+00010 ENTR (Test Position Entry)

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6.2.16.7.59 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.60 In approximately 12 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R2 [707 (NBDY-NBDX) +.5 (AD1AY-AD1AX) +.5 ADSRAZ] Position +00010.

6.2.16.7.61 Terminate this test by entering in K-148 the following:

VERB 36 ENTR

6.2.16.7.62 On K-148 enter the following sequence:

VERB 41 NOUN 20 ENTR

+00000 ENTR

+00000 ENTR

+00000 ENTR

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6.2.16.10 Calculations

Table XXI

Position No. As Displayed in R3	Quantity Being Measured
+00001	+NBDY +X PIPA G
+00002	+NBDZ -X PIPA G -NBDX + ADIAX
+00003	-NBDX +Z PIPA G
+00004	+NBDY + ADSRAY -Z PIPA G +NBDZ + ADIAZ
+00005	+ Y PIPA G
+00006	- Y PIPA G
+00007	-NBDX + .707 ADSRAX
+00008	.707 (-NBDZ - NBDY) + .5 (ADIAZ - ADIAY) +.5 (ADSRAY + ADSRAZ)
+00009	-NBDZ + .707 ADSRAZ
+00010	.707 (NBDY - NBDX) + .5 (ADIAY - ADIAX) +.5 (ADSRAX)

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6.2.16.10.1 Measured Values

	<u>Line</u>	<u>Position No.</u>	<u>Step No.</u>	<u>Parameter</u>	<u>Recorded Value</u>
6.2.16.10.1.1	1	+00001	6.2.16.7.10	+NBDY	R2
6.2.16.10.1.2	2	+00001	6.2.16.7.12	+XPIPAG	R1 . R2
6.2.16.10.1.3	3	+00002	6.2.16.7.16	+NBDZ	R2
6.2.16.10.1.4	4	+00002	6.2.16.7.18	-XPIPAG	R1 . R2
6.2.16.10.1.5	5	+00002	6.2.16.7.20	-NBDX + ADIAZ	R2
6.2.16.10.1.6	6	+00003	6.2.16.7.24	-NBDX	R2
6.2.16.10.1.7	7	+00003	6.2.16.7.26	+ZPIPAG	R1 . R2
6.2.16.10.1.8	8	+00004	6.2.16.7.30	+NBDY + ADSRAY	R2
6.2.16.10.1.9	9	+00004	6.2.16.7.32	-ZPIPAG	R1 . R2
6.2.16.10.1.10	10	+00004	6.2.16.7.36	+NBDZ + ADIAZ	R2
6.2.16.10.1.11	11	+00005	6.2.16.7.38	+YPIPAG	R1 . R2
6.2.16.10.1.12	12	+00006	6.2.16.7.44	-YPIPAG	R1 . R2
6.2.16.10.1.13	13	+00007	6.2.16.7.48	-NBDX + .707ADSRAX	R2
6.2.16.10.1.14	14	+00008	6.2.16.7.82	.707 (-NBDZ - NBDY) + .5 (ADIAZ - ADIAY) +.5 (ADSRAY + ADSRAZ)	R2
6.2.16.10.1.15	15	+00009	6.2.16.7.86	-NBDZ + .707ADSRAX	R2
6.2.16.10.1.16	16	+00010	6.2.16.7.88	.707 (NBDY - NBDX) + .5 (ADIAZ - ADIAZ) + .5 ADSRAX	R2

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6.2.16.10.2 Obtain data from last historical IRIG and PIPA test and complete Table X₁₋₁.

TABLE X₁₋₁

PARAMETER	UNITS	RECORDED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADLAX	meru/g	
ADLAY	meru/g	
ADIAZ	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

6.2.16.10.3 Obtain data from the second last historical IRIG and PIPA test and complete Table X₁₋₂.

TABLE X₁₋₂

PARAMETER	UNITS	RECORDED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADLAX	meru/g	

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TABLE X₁₋₂ (Continued)

PARAMETER	UNITS	RECORDED VALUE
AD1AY	meru/g	
AD1AZ	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

6.2.16.10.4 Obtain data from the third last historical IRIG and PIPA test and complete Table X₁₋₃.

TABLE X₁₋₃

PARAMETER	UNITS	RECORDED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
AD1AX	meru/g	
AD1AY	meru/g	
AD1AZ	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

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6.2.16.10.5 Compute the PIPA Scale Factor error in parts per million and record in Table X.

a. PIPA S. F. Error = $\left[\frac{(2 \text{ local g})}{+PIPAG - (-PIPAG)} - 1.000000 \right] 10^6$

b. X PIPA S. F. Error = $\left[\frac{(2 \text{ local g})}{\text{line 2} - \text{line 4}} - 1.000000 \right] 10^6$

c. Y PIPA S. F. Error = $\left[\frac{(2 \text{ local g})}{\text{line 11} - \text{line 12}} - 1.000000 \right] 10^6$

d. Z PIPA S. F. Error = $\left[\frac{(2 \text{ local g})}{\text{line 7} - \text{line 9}} - 1.000000 \right] 10^6$

The PIPA S. F. Error shall not exceed ± 1900 PPM.

6.2.16.10.6 Compute the PIPA Bias in cm/sec^2 and record in Table X₁.

a. PIPA Bias = $\frac{+PIPAG + (-PIPAG)}{2} = \text{---} \text{ cm/sec}^2$

b. X PIPA Bias = $\frac{\text{line 2} + \text{line 4}}{2} =$

c. Y PIPA Bias = $\frac{\text{line 11} + \text{line 12}}{2} =$

d. Z PIPA Bias = $\frac{\text{line 7} + \text{line 9}}{2} =$

The PIPA Bias shall not exceed $\pm 2.28 \text{ cm/sec}^2$.

6.2.16.10.7 Calculate NBD, ADSRA, and ADIA and record in Table X₁.

a. NBDX = $-(\text{line 6}) =$
 NBDY = $\text{line 1} =$
 NBDZ = $\text{line 3} =$
 NBD shall not exceed ± 15 meru.

b. ADSRAX = $\frac{(\text{line 13} - \text{line 6})}{.707} =$

ADSRAY = $\text{line 8} - \text{line 1}$

ADSRZ = $\frac{\text{line 15} + \text{line 3}}{.707}$

ADSRZ shall not exceed ± 40 meru/g.

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c. ADIAX = line 5 - line 6

$$ADIA Y = \text{line } 16 - \frac{.707 (\text{NBDY} - \text{NBDX}) - .5 (\text{ADSRAX} - \text{ADIAX})}{.5}$$

ADIAZ = line 10 - line 3

ADIA shall not exceed ± 100 meru/g.

TABLE X₁

PARAMETER	UNITS	CALCULATED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAX	meru/g	
ADIAX	meru/g	
ADIA Y	meru/g	
ADIAZ	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

6.2.16.10.8 Perform the following calculations for each term in Table X₁, and record the results in Table D.

$$D_1 = |X_{i-1} - X_i|$$

$$D_2 = |X_{i-1} - X_i| + |X_{i-2} - X_{i-1}|$$

$$D_3 = |X_{i-3} - X_{i-2}| + |X_{i-2} - X_{i-1}| + |X_{i-1} - X_i|$$

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X_1 = data point just obtained
 X_{1-1} = last historical data point
 X_{1-2} = second last historical data point
 X_{1-3} = third last historical data point

NOTE: D_1 calculations begin with the first data point
 after ISS Pre-Vib; D_2 calculations begin with the
 second data point after ISS Pre-Vib; D_3 calculations
 begin with the third data point after Pre-Vib.

TABLE D

PARAMETER	UNITS	D_1	MAX	D_2	MAX	D_3	MAX
NBDX	meru		6		9		11
NBDY	meru		6		9		11
NBDZ	meru		6		9		11
ADSRAX	meru/g		14		21		25
ADSRAY	meru/g		14		21		25
ADSRAZ	meru/g		14		21		25
ADIAx	meru/g		17		33		40
ADIAy	meru/g		17		33		40
ADIAz	meru/g		17		33		40
X PIPA S. F. Error	PPM		400		500		600
Y PIPA S. F. Error	PPM		400		500		600
Z PIPA S. F. Error	PPM		400		500		600
X PIPA Bias	cm/sec ²		0.5		0.7		0.9
Y PIPA Bias	cm/sec ²		0.5		0.7		0.9
Z PIPA Bias	cm/sec ²		0.5		0.7		0.9

6.2.16.10.9 Failure to meet the above criteria shall result in retest according to paragraph 5.4.2.

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- 6.2.17.1 SXT-NB-IMU Fine Alignment Test
- 6.2.17.1 Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.17.2 Prior to performing this test, the G&N Installation Qualification fixture shall be installed on the supporting fixture and adjusted to permit proper operation of the G&N optics. The azimuth supplied by the azimuth autoset (Optical Reference No. 1) shall be known to ± 30 minutes of arc.

NOTE: The G&N shall have had OPERATE power applied for a minimum of 1 hour. Set the G/N POWER-OPTICS switch to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $+28.0 \pm 3.0$ VDC. Verify that the OPTX 28V 800 cps 1% zero (CG1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.

- 6.2.17.3 Enter VERB 01 NOUN 10 into K148. Press the ENTER pushbutton. Enter 00003 into K148. Press the ENTER pushbutton. Record R1 = AAAAA.

If the recorded value is within any of the sets of limits given in Table 1 proceed with the test. If the recorded value is NOT within any of the sets of limits wait 30 minutes and then repeat this step.

TABLE 1

MIN VALUE			MAX VALUE
00000	<	AAAAA	< 03242
04000	<	AAAAA	< 07242
10000	<	AAAAA	< 13242
14000	<	AAAAA	< 17242
20000	<	AAAAA	< 23242
24000	<	AAAAA	< 27242
30000	<	AAAAA	< 33242
34000	<	AAAAA	< 37242

- 6.2.17.4 Enter the following sequence into the Lower Equipment Bay (LEB) DSKY.
- VERB 41 NOUN 20 ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER
- 6.2.17.5 On the G&N Indicator Control Panel set the following switches to the position indicated.
- TELESCOPE TRUNNION to SLAVE to SXT
 - CONTROLLER COUPLING to DIRECT
 - CONTROLLER SPEED to LO
 - OPTICS MODE to MAN

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6.2.17.6 Enter the following into the DSKY.

- a. VERB 01 NOUN 01, ENTER
- b. 00362, ENTER
- Record R1 = XXXXY

6.2.17.7 Enter the following into the DSKY

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table II and XXXX is that recorded in 6.2.17.9.

TABLE II

Y (From 6.2.17.9)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.17.8 Initiate the test by entering the following sequence into the LEB DSKY.

- a. VERB 57, ENTER
- b. 00003, ENTER

6.2.17.9 Observe VERB 06 NOUN 01 flashing on the DSKY. The following data is displayed in R1 and R2 on the DSKY.

- a. R1 = +13500
- b. R2 = +xx.xxx (Site Latitude from Table I)

TABLE I

Test Site	Latitude
NAA	+33.922
MILA	+28.516
MSC	+29.556

6.2.17.10 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If the value displayed is other than +13500 in R1 and the correct Site Latitude in R2, correct the data by entering the following sequence into the DSKY.

- a. VERB 21, ENTER
- b. +13500, ENTER
- c. VERB 22, ENTER
- d. +xx.xxx, ENTER (+xx.xxx = Site Latitude from Table I)
- e. VERB 33, ENTER

6.2.17.11 Observe VERB 21 NOUN 30 flashing on the DSKY. Enter the following sequence into the DSKY.

- a. +00001, ENTER (Position Number)
- b. +00000, ENTER
- c. +00001, ENTER

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- 6.2.17.12 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Y_{NB} Azimuth)
 - R2 = ±xx.xxx (Y_{NB} Elevation)
 - R3 = 00001
- 6.2.17.13 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct YNB azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx ± 002.00 degrees, ENTER (Y_{NB} azimuth)
 - ±xx.xxx ± 02.000 degrees, ENTER (Y_{NB} elevation)
 - VERB 33, ENTER
- 6.2.17.14 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Z_{NB} Azimuth)
 - R2 = ±xx.xxx (Z_{NB} Elevation)
 - R3 = 00002
- 6.2.17.15 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct ZNB azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx ± 002.00 degrees, ENTER (Z_{NB} Azimuth)
 - ±xx.xxx ± 02.000 degrees, ENTER (Z_{NB} elevation)
 - VERB 33, ENTER
- 6.2.17.16 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Target 1 Azimuth)
 - R2 = ±xx.xxx (Target 1 Elevation)
 - R3 = 00001
- 6.2.17.17 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct azimuth and elevation for Target 1, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx ± 000.10 degrees, ENTER (Target 1 Azimuth)
 - ±xx.xxx ± 00.010 degrees, ENTER (Target 1 Elevation)
 - VERB 33, ENTER
- 6.2.17.18 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Target 2 Azimuth)
 - R2 = ±xx.xxx (target 2 Elevation)
 - R3 = 00002

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- 6.2.17.19 If the data displayed is correct proceed to 6.2.17.20. If R1 and R2 do not contain the correct azimuth and elevation for Target 2, correct the data by entering the following sequence into the DSKY.
- a. VERB 24, ENTER
 - b. $\pm xxx. xxx \pm 000.10$ degrees, ENTER (Target 2 Azimuth)
 - c. $\pm xx. xxx \pm 00.010$ degrees, ENTER (Target 2 Elevation)
- 6.2.17.20 Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN. Enter VERB 33, ENTER into the DSKY.
- 6.2.17.21 When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00001, set the OPTICS MODE switch on the G&N Indicator Control Panel to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.
- 6.2.17.22 Using the Optics Band Controller, align the SXT StLOS with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.23 When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00002 set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.
- 6.2.17.24 Using the Optics Hand Controller, align the SXT StLOS with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.
- NOTE: The following two MARKS must be performed as quickly as possible. In no case shall the time between the first and second MARK exceed two minutes.
- 6.2.17.25 After 90 seconds observe the DSKY for VERB 51 NOUN 30 flashing and R1 = 00001. Set the Optics Mode switch to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.
- 6.2.17.26 Using the Optics Hand Controller, align the SXT StLOS with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.

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- 6.2.17.27 When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00002 set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.
- 6.2.17.28 Using the Optics Hand Controller, align the SXT StLOS with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.29 Repeat steps 6.2.17.27 through 6.2.17.28.
- 6.2.17.29 In approximately 7 minutes VERB 06 NOUN 66 shall flash on the DSKY and the test results shall be displayed. R1 and R2 on the DSKY shall display the misalignment of one of the horizontal PIPA's in arc seconds (R1 = whole, R2 = fractional). Record R1 and R2. (See Table II for PIPA displayed).
- 6.2.17.30 Enter VERB 33 ENTER into the DSKY. When VERB 06 NOUN 66 flashes, R1 and R2 on the DSKY shall display the misalignment of the second horizontal PIPA in arc seconds (R1 whole, R2 fractional). (See Table II for PIPA displayed.) Record R1 and R2.
- 6.2.17.31 Enter VERB 34 ENTER into the DSKY to terminate the test. Wait 5 seconds.
- 6.2.17.32 Repeat steps 6.2.17.3 and 6.2.17.8 through 6.2.17.31 substituting No. 00002 in 6.2.17.11.a.
- 6.2.17.33 Enter the following into the DSKY.
- VERB 36, ENTER
 - VERB 41 NOUN 20, ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER

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Table II. Display Conditions at Test Completion

Position	SM Orientation			Horizontal Misalignment Component	
	X_{SM}	Y_{SM}	Z_{SM}	6.2.17.29	6.2.17.30
1	UP	SW	SE	Y_{SM}	Z_{SM}
2	SE	SW	DN	X_{SM}	Y_{SM}
3*	SE	UP	SW	X_{SM}	Z_{SM}

* Position 3 is not run in the Spacecraft because of GIMBAL LOCK considerations.

6.2.17.35 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.17.36 Calculations

- 6.2.17.36.1
- Y_{SM} misalignment = () $\frac{R1 \cdot R2}{}$
 - Z_{SM} misalignment = () $\frac{R1 \cdot R2}{}$
 - X_{SM} misalignment = () $\frac{R1 \cdot R2}{}$
 - Y_{SM} misalignment = () $\frac{R1 \cdot R2}{}$

6.2.17.36.2 Enter the latest values from 6.2.16 IMU Performance Test.

- X PIPA bias = _____ cm/sec²
- Y PIPA bias = _____ cm/sec²
- Z PIPA bias = _____ cm/sec²
- $\theta_x = 210$ (X PIPA bias) = _____ arc sec.
- $\theta_y = 210$ (Y PIPA bias) = _____ arc sec.
- $\theta_z = 210$ (Z PIPA bias) = _____ arc sec.

- 6.2.17.36.3
- Y_{SM} misalignment (Bias corrected) = 6.2.17.36.1a - θ_y = _____ arc sec.
 - Z_{SM} misalignment (Bias corrected) = 6.2.17.36.1b - θ_z = _____ arc sec.
 - X_{SM} misalignment (Bias corrected) = 6.2.17.36.1c - θ_x = _____ arc sec.
 - Y_{SM} misalignment (Bias corrected) = 6.2.17.36.1d - θ_y = _____ arc sec.

The SM misalignments in each orientation, excluding PIPA bias, shall not exceed ± 150 arc seconds.

6.2.18 Gyrocompassing Test

NOTE: Perform Master Initialization 6.2.5.3 before proceeding.

6.2.18.1 Set the G/N POWER-OPTICS Switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0 \pm 3.0 VDC. Verify that OPTX 28V 800 ops 1% zero (CG 1211) and OPTX 28V 800 ops 5% - 90°h (CG 1212) are not flashing on the CRT.

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6.2.18.2 Enter the following into the DSKY.

- a. VERB 01 NOUN 01, ENTER
- b. 00362, ENTER
- Record R1 = XXXXY

6.2.18.3 Enter the following into the DSKY.

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY, ENTER where Y' is determined by Table II and XXXX is that recorded in 6.2.18.2.

Table II

Y (From 6.2.18.2)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.18.4 Enter the following sequence into the K-Start, pressing ENTER pushbutton after each entry.

- a. VERB 57, ENTER
- b. 00006, ENTER

6.2.18.5 System shall advance to Gyrocompass System Test and display 01 on the CRT program display.

6.2.18.6 On the CRT observe VERB 06, NOUN 61 flashing with some launch azimuth displayed in R1 = +xxx.xx.

6.2.18.6.1 If the azimuth displayed is correct proceed to 6.2.18.5; if not, perform the following sequence:

- a. VERB 21, Press ENTER pushbutton
- b. +xxx.xx, press ENTER pushbutton (Correct Launch Azimuth)

6.2.18.7 After verifying that the correct launch azimuth is displayed in R1 on the CRT, Enter VERB 33 on the K-START and push the ENTER pushbutton.

6.2.18.8 Observe VERB 06 NOUN 61 flashing on the CRT with the following displayed in R1 and R2.

- a. R1 = +xxx.xx, Nav. Base Azimuth (Z_{NB})
- b. R2 = +xx.xxx, Site Latitude

6.2.18.8.1 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence:

To correct R1:

- a. VERB 21, ENTER
- b. +xxx.xx±000.50 degrees, ENTER (Z_{NB} Azimuth)

To correct R2:

- a. Verb 22, ENTER
- b. +xx.xxx, ENTER (Correct Site Latitude from Table I)

NOTE: Using the beginning of Prog 02 as T₀ initial start time, read/record CDUX, CDUY & CDUZ every 15 minutes for 120 min. and every 5 minutes for the next 60 minutes.

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6.2.18.9 After the correct data for R1 and R2 are verified enter VERB 33 into the K-Start. Press the ENTER pushbutton. On the CRT observe the PROGRAM display change to 05 after approximately 90 seconds. After approximately 5 minutes, observe the PROGRAM display change to 02.

6.2.18.10 Between 175 minutes and 180 minutes from T₀ set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.

6.2.18.10.1 Enter the following into the DSKY:

- a. Verb 21 Noun 03, Enter
- b. 02663 Enter
- c. +XXX.XX ±000.01 Enter (Target No. 1 Az)
- d. Press Enter Pushbutton
- e. 02664 Enter
- f. +XXX.XX +000.01 Enter (Target No. 2 Az)
- g. Press Enter Pushbutton
- h. 02665 Enter
- i. +00.000 Enter (Target No. 1 EL)
- j. Press Enter Pushbutton
- k. 02666 Enter
- l. +00.000 Enter (Target No. 2 EL)

On the G&N Indicator Control Panel set the optics mode switch to MAN and the Controller Speed Switch to HI. Drive the StLOS to the approximate position of Target No. 1. Set the Controller Speed Switch to LO.

NOTE: Read the following 10 steps before proceeding. These are time critical steps and must be performed as rapidly as possible.

6.2.18.11 After 180 minutes from T₀ enter VERB 52 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT change to 03.

6.2.18.12 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 1 azimuth and elevation.

- a. R1 = +xxx.xx (Target 1 azimuth)
- b. R2 = +00.000 (Target 1 elevation)

6.2.18.13 Verify the data appearing in R1 and R2 and if correct, proceed. If not correct, perform the following sequence.

- a. VERB 24, ENTER
- b. +xxx.xx ±000.01, ENTER (Target 1 azimuth)
- c. +00.000, ENTER (Target 1 elevation)

6.2.18.14 After the correct readings for R1 and R2 are verified, enter VERB 33 into the K-Start. Press the ENTER pushbutton.

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- 6.2.18.15 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 2 azimuth and elevation.
- R1 = +xxx.xx (Target 2 azimuth)
 - R2 = +00.000 (Target 2 elevation)
- 6.2.18.16 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence:
- VERB 24, ENTER
 - +xxx.xx \pm 000.01, ENTER (Target 2 azimuth)
 - +00.000, ENTER (Target 2 elevation)
- 6.2.18.17 After the correct readings for R1 and R2 are verified enter VERB 33 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.18 Using the Optics Hand Controller, align the SXT StLOS to target 1 and press the MARK pushbutton. If satisfied that the MARK was good, proceed. If not satisfied with MARK, press the MARK REJECT pushbutton and repeat the step.
- 6.2.18.19 Set the CONTROLLER SPEED switch to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target 2.
- 6.2.18.20 Set the CONTROLLER SPEED switch to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 2 and press the MARK pushbutton. If satisfied that the MARK was good, press the ENTER pushbutton. If not satisfied, press the MARK REJECT pushbutton and repeat this step.
- 6.2.18.21 On the CRT observe the following data displayed:
- VERB 06 NOUN 60
 - R1 = \pm xx.xxx (X gyro elevation error, degrees)
 - R2 = \pm xx.xxx (Y gyro elevation error, degrees)
 - R3 = \pm xx.xxx (Z gyro azimuth error, degrees)
- Record R1, R2 and R3.
- 6.2.18.22 Enter VERB 34 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT and DSKY's indicates 02. Set the OPTICS MODE Switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.23 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.24 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start three times. Press the ENTER pushbutton after each entry. Set the G/N POWER OPTICS Switch on the LEB Lighting Control Panel to OFF.

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6.2.18.25 Data Sheet

TIME	CDUX	CDUY	CDUZ
To			
To +15			
To +30			
To +45			
To +60			
To +75			
To +90			
To +105			
To +120			
To +125			
To +130			
To +135			
To +140			
To +145			
To +150			
To +155			
To +160			
To +165			
To +170			
To +175			
To +180			

- NOTES: 1. Record CDU angles at times indicated. (T_0 is the time at the start of test - Prog 02)
2. The 2 hr data ($T_0 + 120$ minutes) is baseline.

Tolerance: Tolerance is $0.00 \pm 0.06^\circ$ delta from 2 hr baseline for CDUX, and $0.00 \pm 0.03^\circ$ delta from 2 hr baseline for CDUY & CDUZ for the 120 minute to 180 minute recordings only.

Line	Step	Parameter	Recorded Value
1	6.2.18.21	X Gyro Elevation Error	$\pm R1$ degrees
2		Y Gyro Elevation Error	$\pm R2$ degrees
3		Z Gyro Azimuth Error	$\pm R3$ degrees

6.2.18.26 Calculation Sheet

6.2.18.26.1 Record the most recent values of the following coefficients from 6.2.16, IMU Performance Test.

- a. NBDX = () _____
- b. NBDY = () _____
- c. NBDZ = () _____
- d. ADIAZ = () _____
- e. ADSRAY = () _____

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6.2.18.26.2 Perform the following calculations. (Cos λ functions are provided in Table I.)

- a. $D_{(vert)} = NBDZ + ADIAZ$
 $D_{(vert)} = () \text{ meru}$
- b. $D_{(east)} = \sin(\text{Launch Az}) NBDX + \cos(\text{Launch Az}) NBDY + ADSRAY$
- c. $\phi_{(vert)} = \frac{D_{(vert)} \times \cos \lambda + D_{(east)} \times \frac{206}{3600} \times \cos \lambda}{3600}$
 $\phi_{(vert)} = () \text{ degrees}$

Table I

Location	Latitude λ	Cos λ
NAA	33.921	0.82985
MILA	28.516	0.87868
MSC	29.556	0.86993

6.2.18.26.3 Perform the following calculations using the recorded data from 6.2.18.25 and 6.2.18.26.2.

- a. Z Gyro azimuth error 3 hrs (corrected) = line 3 - $\phi_{(vert)}$
Z Gyro azimuth error 3 hrs (corrected) = _____ corrected
Z Gyro azimuth error (corrected) shall be 0.00 ± 0.57 degrees.
- b. X Gyro elevation error (3 hr) = line 1 _____
X Gyro elevation error (3 hr) = _____ degrees
- c. Y Gyro elevation error (3 hr) = line 2 _____
Y Gyro elevation error (3 hr) = _____ degrees
The X and Y Gyro elevation errors shall be 0.00 ± 0.06 degrees.

6.2.19 CMC Voltage Margin Test

6.2.19.1 Verify that the G&N IMU HTR MNA and MNB breakers are engaged, computer MNA and MNB breakers are engaged, IMU MNA and MNB breakers are not engaged, and the G&N Power-IMU switch on the LEB Lighting Control Panel is in the OFF position.

6.2.19.2 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to ON.

CAUTION: During the performance of this test the +4 VDC CMC Power Supply shall not be operated at less than +2.5 VDC or greater than 5.2 VDC (CG 1030). The +14 VDC CMC Power Supply shall not be operated at less than +8.5 VDC or greater than +17.0 VDC (CG 1020). Rotate the LEB LTS NUMERICS SEL to approximately center position. Decrease to absolute minimum

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6.2.19.2
(cont)

discernible lighting.

NOTE: The flashing indication of the CMC Power Supplies on CRT may be disregarded for this test. The charts in Table I may be used to determine approximate values for the "XX.X" values of C-156 voltage dial settings corresponding to various power supply voltages.

6.2.19.3

Units R-154, insert 0001. Verify and execute.

6.2.19.4

Insert in C-156, -040001244 and execute. Verify on CRT that GV0116 is between -3.0 and -5.0 vdc.

6.2.19.5

Insert in C-156 -050001234 and execute. Verify on CRT that GV0106 is between -4.0 and -6.0 vdc.

6.2.19.6

Units R-154, insert 0111. Verify and execute.

6.2.19.7

Observe CG 1020, +14 VDC Power Supply, and CG 1030, +4 VDC Power Supply on CRT. Repeat 6.2.19.3 through 6.2.19.6 adjusting each C Start entry until CG 1020 is 12.1, +0.1, -0.0 vdc and CG 1030 is 3.40, +0.03, -0.00 vdc.

6.2.19.8

Initiate CMC Self Check by inserting the following in K-148.

- a. ERROR RESET
- b. VERB 21, NOUN 27, ENTER
- c. 77777, ENTER

Wait 200 seconds.

6.2.19.9

Insure that the DSKY RESTART lamp does not light, and that

- a. VERB 05 NOUN 31
- b. R1 = 01102

does not appear on DSKY.

6.2.19.10

Set INHIBIT VOLTAGE FAIL switch to OFF on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. If RESTART lamp does not light, repeat 6.2.19.3. Verify CMC Warning master alarms are lighted.

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- 6.2.19.11 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- ERROR RESET
 - VERB 21, NOUN 27, ENTER
 - 77777, ENTER
- 6.2.19.12 Units R-154, insert 0001. Verify and execute.
- 6.2.19.13 Insert in C-156 +108001244 and execute. Verify on CRT that GV0116 is between +0.8 and +11.8 vdc.
- 6.2.19.14 Units R-154, insert 0111. Verify and execute.
- 6.2.19.15 Observe CG 1020, +14 VDC Power Supply on CRT. Repeat 6.2.19.12 through 6.2.19.14 adjusting the C Start entry until CG 1020 is 16.4, +0.0, -0.1 vdc.
- 6.2.19.16 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- VERB 05, NOUN 31
 - R1 = 01102
- does not appear on DSKY.
- 6.2.19.17 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted. ~~Repeat 6.2.19.17 measuring CG 1020 and CG 1030 at PSAAM interface instead of CRT.~~
- 6.2.19.18 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- ERROR RESET
 - VERB 21, NOUN 27, ENTER
 - 77777, ENTER
- 6.2.19.19 Units R-154, insert 0001. Verify and execute.
- 6.2.19.20 Insert in C-156, +082001234 and execute. Verify on CRT that GV0106 is between +8.2 and +10.2 vdc.
- 6.2.19.21 Units R-154, insert 0111. Verify and execute.
- 6.2.19.22 Observe CG 1030, +4 VDC Power Supply on CRT. Repeat 6.2.19.19 through 6.2.19.21 adjusting the C Start entry until CG 1030 is 4.60, +0.00, -0.03 vdc.
- 6.2.19.23 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- VERB 05, NOUN 31
 - R1=01102
- does not appear on DSKY.

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- 6.2.19.24 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted. ~~Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:~~
and CG 1030 at PSAAM Interface instead of CRT.
- 6.2.19.25 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- a. ERROR RESET
 - b. VERB 21, NOUN 27, ENTER
 - c. 77777, ENTER.
- 6.2.19.26 Units R-154, insert 0001. Verify and execute.
- 6.2.19.27 Insert in C-156, -040001244 and execute. Verify on CRT that GV0116 is between -3.0 and -5.0 vdc.
- 6.2.19.28 Units R-154, insert 0111. Verify and execute.
- 6.2.19.29 Observe CG 1020, +14 VDC Power Supply on CRT. Repeat 6.2.19.26 through 6.2.19.28 adjusting the C Start entry until CG 1020 is 12.1, +0.1, -0.0 vdc.
- 6.2.19.30 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- a. VERB 05, NOUN 31
 - b. R1 = 01102
- does not appear on DSKY.
- 6.2.19.31 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted. ~~Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:~~
and CG 1030 at PSAAM Interface instead of CRT.
- 6.2.19.32 Units R-154, insert 0000. Verify and execute.
- 6.2.19.33 Terminate CMC Self-Check by inserting into K-148:
- a. ERROR RESET
 - b. VERB 21, NOUN 27, ENTER
 - c. 00000, ENTER
- 6.2.19.34 Ensure that CG 1020, +14 VDC Power Supply indication is +14.0, ± 0.4 , and that CG 1030, +4 VDC Power Supply indication is +4.00 ± 0.20 VDC on CRT.

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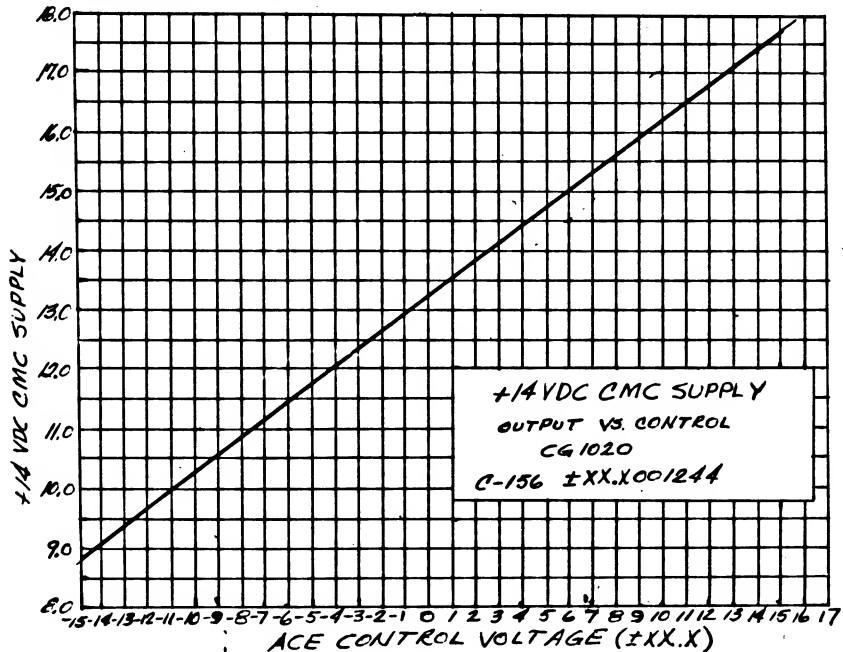
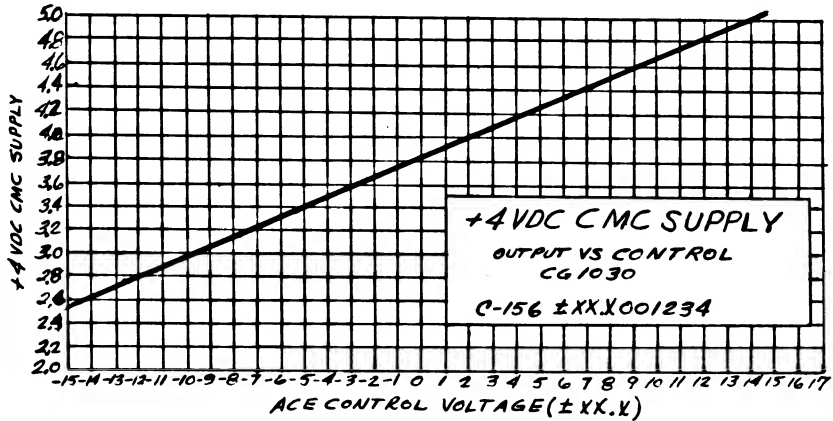


TABLE I

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6.2.20 Spacecraft Control and Displays Test

6.2.20.1 Perform Master Initialization before proceeding. If system operation is normal, proceed with the following test sequence.

6.2.20.2 FDAI Attitude Error

6.2.20.2.1 Insert in K148

- a. V 57 ENTER
- b. 00013 ENTER

6.2.20.2.2 Observe on CRT

- a. V 06 NO1 Flashing
- b. PROG 07
- c. NO ATT ON
- d. R1, R2, and R3 Approx. 00000

6.2.20.2.3 Insert in K148

- a. VERB 33, ENTER

6.2.20.2.4 Observe on CRT

- a. V 06 NO1 Flashing
- b. R1 +00385
- c. R2 -00385
- d. R3 +00385
- e. NO ATT OFF

6.2.20.2.5 Record CRT indications

- a. CG 2279 ROLL ATT ERROR - CDU DAC OUT $\pm 5.06 \pm 0.50$ VRMS
- b. CG 2219 PITCH ATT ERROR - CDU DAC OUT $\pm 5.06 \pm 0.50$ VRMS
- c. CG 2249 YAW ATT ERROR - CDU DAC OUT $\pm 5.06 \pm 0.50$ VRMS

6.2.20.2.6 Insert in K148

- a. VERB 33, ENTER

6.2.20.2.7 Observe on CRT

- a. V 06 NO1 Flashing
- b. R1 +00384
- c. R2 -00384
- d. R3 +00384

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6.2.20.2.8 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	+5.06±0.50VRMS
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	-5.06±0.50VRMS
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	+5.06±0.50VRMS

6.2.20.2.9 Insert in KI48

a. VERB 33, ENTER

6.2.20.2.10 Observe on CRT

a.	V 06	NO1	Flashing
b.	R1		+00160
c.	R2		-00160
d.	R3		+00160

6.2.20.2.11 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	+5.11±0.21 VRMS
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	+5.11±0.21 VRMS
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	+5.11±0.21 VRMS

6.2.20.2.12 Insert in KI48

a. VERB 33, ENTER

6.2.20.2.13 Observe on CRT

a.	V 06	NO1	Flashing
b.	R1		+00135
c.	R2		-00135
d.	R3		+00135

6.2.20.2.14 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	+1.78±0.18 VRMS
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	-1.78±0.18 VRMS
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	+1.78±0.18 VRMS

6.2.20.2.15 Insert in KI48

a. VERB 33, ENTER

6.2.20.2.16 Observe on CRT

a.	V 06	NO1	Flashing
b.	R1		+00090
c.	R2		-00090
d.	R3		+00090

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6.2.20.2.17 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	+1.19±0.12 VRMS _{es}
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	-1.19±0.12 VRMS _{es}
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	+1.19±0.12 VRMS _{es}

6.2.20.2.18 Insert in K148

a. VERB 33, ENTER

6.2.20.2.19 Observe on CRT

a. V 06	N01	Flashing
b. R1		+00000
c. R2		+00000
d. R3		-00090

6.2.20.2.20 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	0.00±0.08 VRMS _{es}
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	0.00±0.08 VRMS _{es}
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-1.19±0.12 VRMS _{es}

6.2.20.2.21 Insert in K148

a. VERB 33, ENTER

6.2.20.2.22 Observe on CRT

a. V 06	N01	Flashing
b. R1		-00090
c. R2		+00090
d. R3		-00135

6.2.20.2.23 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-1.19±0.12 VRMS _{es}
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+1.19±0.12 VRMS _{es}
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-1.78±0.18 VRMS _{es}

6.2.20.2.24 Insert in K148

a. VERB 33, ENTER

6.2.20.2.25 Observe on CRT

a. V 06	N01	Flashing
b. R1		-00135
c. R2		+00135
d. R3		-00160

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6.2.20.2.26 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-1.78±0.18 VRMS
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+1.78±0.18 VRMS
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-2.11±0.21 VRMS

6.2.20.2.27 Insert in K148

a. VERB 33, ENTER

6.2.20.2.28 Observe on CRT

a. V 06	N01	Flashing
b. R1		-00160
c. R2		+00160
d. R3		-00384

6.2.20.2.29 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-2.11±0.21 VRMS
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+2.11±0.21 VRMS
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-5.06±0.50 VRMS

6.2.20.2.30 Insert in K148

a. VERB 33, ENTER

6.2.20.2.31 Observe on CRT

a. V 06	N01	Flashing
b. R1		-00384
c. R2		+00384
d. R3		-00385

6.2.20.2.32 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-5.06±0.50 VRMS
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+5.06±0.50 VRMS
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-5.06±0.50 VRMS

6.2.20.2.33 Insert in K148

a. VERB 33, ENTER

6.2.20.2.34 Observe on CRT

a. V 06	N01	Flashing
b. R1		-00385
c. R2		+00385
d. R3		+00000

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6.2.20.2.35 Record CRT indications

- | | | |
|------------|-------------------------------|---------------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | -5.08±0.50 VRMS rms |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +5.06±0.50 VRMS rms |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | 0.00±0.06 VRMS rms |

6.2.20.2.36 Insert in K148

- | | | |
|----------|-----|-------|
| a. V 21 | N01 | ENTER |
| b. 02545 | | ENTER |
| c. 03302 | | ENTER |
| d. V 33 | | ENTER |

6.2.20.2.37 Observe on CRT

- | | | |
|-----------|-----|----------------------|
| a. V 96 | N03 | Flashing |
| b. NO ATT | | ON |
| c. R1 | | +00000 approximately |
| d. R2 | | +00000 approximately |
| e. R3 | | +00000 approximately |

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6.2.20.3 TVC Test

6.2.20.3.1 The G/N Autopilot Control and SPS Ready discretes shall be applied to the G/N interface.

6.2.20.3.2 Set the OPTICS MODE selector on the Indicator Control panel to MAN.

6.2.20.3.3 Insert in K148

a. VERB 33, ENTER

6.2.20.3.4 Observe on CRT

a. V 01	N 10	Flashing
b. R1		X7373
c. R3		00030

6.2.20.3.5 Insert in K148

a. V 33 ENTER

6.2.20.3.6 Observe on CRT

a. V 01	NOUN 10	Flashing
b. R1		37777
c. R3		00031

6.2.20.3.7 Insert in K148

a. V 33 ENTER

6.2.20.3.8 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00385
c. R2		-00385
d. R3		+00003

6.2.20.3.9 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+16.88-10.12±1.00 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	-16.88-10.12±1.00 VRMS

6.2.20.3.10 Insert in K148

a. VERB 33, ENTER

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6.2.20.3.11 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00384
c. R2		-00384
d. R3		+00003
e. NO ATT		OFF

6.2.20.3.12 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+10.12±1.00 VRMS _{sec}
b. CG 3721	SHAFT CDU DAC OUTPUT	-10.12±1.00 VRMS _{sec}

6.2.20.3.13 Insert in KL48

a. VERB 33, ENTER

6.2.20.3.14 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00160
c. R2		-00160
d. R3		+00003

6.2.20.3.15 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+4.22±0.42 VRMS _{sec}
b. CG 3721	SHAFT CDU DAC OUTPUT	-4.22±0.42 VRMS _{sec}

6.2.20.3.16 Insert in KL48

a. VERB 33, ENTER

6.2.20.3.17 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00135
c. R2		-00135
d. R3		+00003

6.2.20.3.18 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+3.56±0.36 VRMS _{sec}
b. CG 3721	SHAFT CDU DAC OUTPUT	-3.56±0.36 VRMS _{sec}

6.2.20.3.19 Insert in KL48

a. VERB 33, ENTER

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6.2.20.3.20 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00090
c. R2		-00090
d. R3		+00003

6.2.20.3.21 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-2.38±0.24 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	-2.38±0.24 VRMS

6.2.20.3.22 Set the OPTICS CONTROLLER SPEED Switch on the Indicator Control panel to HI.

6.2.20.3.23 Insert in K148

a. VERB 33, ENTER

6.2.20.3.24 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00000
c. R2		+00000
d. R3		+00003

6.2.20.3.25 While holding the Optics Hand Controller up and left (45°) no longer than .10 seconds, record CRT indications.

a. CG 3722	TRUNNION CDU DAC OUTPUT	0.00±0.12 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	0.00±0.12 VRMS

6.2.20.3.26 Insert in K148

a. VERB 33, ENTER

6.2.20.3.27 Observe on CRT

a. V 06	N 03	Flashing
b. R1		-00090
c. R2		+00090
d. R3		+00003

6.2.20.3.28 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-2.38±0.24 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	-2.38±0.24 VRMS

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6.2.20.3.29 Set the OPTICS MODE Switch on the Indicator Control panel to ZERO for 30 seconds, then return to MAN.

6.2.20.3.30 Insert in KI48

a. VERB 33, ENTER

6.2.20.3.31 Observe on CRT

a. V 06	N 03	Flashing
b. R1		-00135
c. R2		+00135
d. R3		+00003

6.2.20.3.32 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-3.56±0.36 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	+8.56±0.36 VRMS

6.2.20.3.33 Insert in KI48

a. VERB 33, ENTER

6.2.20.3.34 Observe on CRT

a. V 06	N 03	Flashing
b. R1		-00160
c. R2		+00160
d. R3		+00003

6.2.20.3.35 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-4.22±0.42 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	+4.22±0.42 VRMS

6.2.20.3.36 Insert in KI48

a. VERB 33, ENTER

6.2.20.3.37 Observe on CRT

a. V 06	N 03	Flashing
b. R1		-00384
c. R2		+00384
d. R3		+00003

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6.2.20.3.38 Record CRT indications

- a. CG 3722 TRUNNION CDU DAC OUTPUT -10.12±1.00 VRMS
- b. CG 3721 SHAFT CDU DAC OUTPUT +10.12±1.00 VRMS

6.2.20.3.39 Insert in K148

- a. VERB 33, ENTER

6.2.20.3.40 Observe on CRT

- a. V 06 N 03 Flashing
- b. R1 -00385
- c. R2 +00385
- d. R3 +00003

6.2.20.3.41 Record CRT indications

- a. CG 3722 TRUNNION CDU DAC OUTPUT -10.12±1.00 VRMS
- b. CG 3721 SHAFT CDU DAC OUTPUT +10.12±1.00 VRMS

6.2.20.3.42 Insert in K148

- a. V 34 ENTER
- b. V 40 N 20 ENTER
- c. V 41 N 20 ENTER
- d. +00000 ENTER
- e. +00000 ENTER
- f. +00000 ENTER

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APPENDIX I

Signal	Link	Nomenclature	G&N Test Requirement	PSAAM and/or SCA Uncertainty % of Full Scale
CG 1020	1	+14 VDC CMC SUPPLY	+14.0 ± 0.4 VDC	0%
CG 1030	1	+4 VDC CMC SUPPLY	+4.00 ± 0.2 VDC	0%
CG 1040	2	+120 VDC PIPA SUPPLY	+120 ± 6.0 VDC	1%
CG 1051	1	+20 VDC PIPA SUPPLY	+20.0 ± 1.2 VDC	0%
CG 1052	1	-20 VDC PIPA SUPPLY	-20 ± 2 VDC	0%
CG 1070	1	+4 VDC CDU SUPPLY	+4.0 ± 0.2 VDC	0%
CG 1100	1	-28 VDC SUPPLY	-27.5 ± 6.0 VDC	0%
CG 1110	2	2.5 VDC TM BIAS	+2.50±0.05 VDC	0%
CG 1201	2	IMU 28V .8KC 1/4 0° RMS	28.00 ± 0.56 VRMS	1%
CG 1202	1	IMU 28V .8 KC 5/8 - 90° RMS	28.0 ± 1.4 VRMS	1.5%
CG 1203	1	IMU 28V .8KC 0° RMS	28.0 ± 2.1 VRMS	1.5%
CG 1207	1	PH DIFF IMU 5/8 0°, -90°	-90±10°	3%
CG 1211	1	OPTX 28V .8KC 1/4 0° RMS	28.00 ± 0.56 VRMS	1.5%
CG 1212	1	OPTX 28V .8KC 5/8 -90° RMS	28.00 ±1.48 VRMS	1.5%
CG 1220	1	PH DIFF OPTX 1/4 IMU 1/4	0° ± 10°	3%
CG 1331	2	3.2 KC 28V SUPPLY	28.6 ± 0.56 VRMS	1%
CG 1336	1	PH DIFF 3.2 KC 28V/CMC SYNC 1	0° ± 10°	3%
CG 1500	1	+28 VDC IMU OPERATE BUS	28.8 ± 3VDC	0%
CG 1510	1	+28 VDC IMU STANDBY BUS	28.8 ± 3 VDC	0%
CG 1520	1	+28 VDC CMC OPERATE BUS	28.8 ± 3 VDC	0%
CG 1530	1	+28 VDC OPTX OPERATE BUS	28.8 ± 3 VDC	0%
CG 2001	2	X PIPA SG O/P	5 VRMS max	3%
CG 2021	2	Y PIPA SG O/P	5 VRMS max	3%
CG 2041	2	Z PIPA SG O/P	5 VRMS max	3%
CG 2108	1	IG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2112	2	IG LX RESOLVER O/P SIN	18.38 ± 1.84 VRMS @ 45°	2.5%
CG 2113	2	IG LX RESOLVER O/P COS	18.38±1.84 VRMS @ 45°	2.5%
CG 2117	2	IG SERVO ERROR IN PHASE	0.0 ± 60mv RMS @ null	2%
CG 2120	1	IG TORQUE MOTOR CURRENT	0.125 amp max during Fine Alignment Torquing	0%
CG 2138	1	MG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2142	2	MG LX RESOLVER O/P SIN	18.38±1.84 VRMS @45°	2.5%
CG 2143	2	MG LX RESOLVER O/P COS	18.38±1.84 VRMS @45°	2.5%
CG 2147	2	MG SERVO ERROR IN PHASE	0.0 ± 60 mv rms @ null	2%
CG 2150	1	MG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	0%
CG 2168	1	OG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2172	2	OG LX RESOLVER O/P SIN	18.38±1.84 VRMS @45°	2.5%
CG 2173	2	OG LX RESOLVER O/P COS	18.38±1.84 VRMS @45°	2.5%
CG 2177	2	OG SERVO ERROR IN PHASE	0.0 ± 60mvRMS @ null	2%
CG 2180	1	OG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	0%
CG1042	1	+120 VDC PIPA SUP NOISE RMS	1.5 VRMS MAX	0%
CG1053	1	+20 VDC PIPA SUP NOISE RMS	1.0 VRMS MAX	0%
CG1071	1	+4 VDC CDU SUP NOISE RMS	1.0 VRSM MAX	0%
CG1501	1	+28V IMU OPERATE BUS NOISE RMS	1.0 VRMS MAX	0%
CG1511	1	+28V IMU STANDBY BUS NOISE RMS	1.0 VRMS MAX	0%
CG1521	1	+28V CMC OPERATE BUS NOISE RMS	2.0 VRMS MAX	0%
CG1531	1	+28V OPTX OPERATE BUS NOISE RMS	2.0 VRMS MAX	0%

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Signal	Link	Nomenclature	G&N Test Requirement	PSAAM and/or SCA Uncertainty % of Full Scale
CG 2219	1	PITCH ATT ERROR - CDU DAC O/P	5.06 ± 0.5 VRMS @ 17°	2%
CG 2220	1	IG CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 2221	1	IG CDU COARSE ERROR	0.0 ± 0.68 VRMS @null	1%
CG 2249	1	YAW ATT ERROR-CDU DAC O/P	5.06 ± 0.5VRMS @ 17°	2%
CG 2250	1	MG CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 2251	1	MG CDU COARSE ERROR	0.0 ± 0.68VRMS @ null	1%
CG 2279	1	ROLL ATT ERROR-CDU DAC O/P	5.06 ± 0.5VRMS @17°	2%
CG 2280	1	OG CDU FINE ERROR	0.0 ± 0.07 VRMS 2 null	1%
CG 2281	1	OG CDU COARSE ERROR	0.0 ± 0.68 VRMS	1%
CG 2300	1	PIPA TEMPERATURE	130.5±1.5°F Operate Mode	2%
CG 3011	2	TRUNNION CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 3021	1	SHAFT CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 3117	1	SXT SHAFT SERVO ERROR IN PH	2 VRMS max	2%
CG 3118	1	SXT TRUNNION SERVO ERROR IN PHASE	2 VRMS max	2%
CG 3140	1	SXT SHAFT TACH C/P	3.3 ± 1.3VRMS @ Hi Rate	2%
CG 3145	1	SXT SHAFT MTR CONTROL WINDING	3.3 ± 1.3VRMS @ Hi Rate	2%
CG 3150	2	SXT TRUNNION TACH O/P	3.3 ± 1.3VRMS @ Hi Rate	2%
CG 3155	1	SXT TRUNNION MTR CONTROL WINDING	0.85 ± 0.35VRMS at Hi Rate	2%
CG 3160	1	SCT SHAFT TACH O/P	3.3 ± 1.3 VRMS @ Hi Rate	2%
CG 3170	1	SCT TRUNNION TACH O/P	0.85 ± 0.35 VRMS @Hi Rate	2%
CG 3721	1	SHAFT CDU DAC O/P	10.12±1.00 VRMS @17°	1%
CG 3722	2	TRUNNION CDU DAC O/P	10.12±1.00 VRMS @ 17°	1%
CG 4300	2	CMC TEMP	87.5±42.5°F	0%
CG 6020	1	PIPA CAL MODULE TEMP	72.5±27.5°F	0%
CG 6021	1	IMU 800 cps 5% TEMP (PSA)	90±30°F	0%
CG 2301	1	IRIG TEMPERATURE	135 ± 2.5°F in Operate	2%
CG 1021	1	+14V CMC SUPPLY NOISE RMS	1.0 VRMS max	0%
CG 1031	1	+4 CMC SUPPLY NOISE RMS	1.0 VRMS max	0%

PSAAM and/or SCA output is the source of Link 1 signals.
SCA output is the source of Link 2 signals.

PSAAM OUTPUT is the source of Link 1 signals
SCA OUTPUT is the source of Link 2 signals.

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ADDENDUM I

SCOPE: The following changes are required to make ND1002325 applicable as G&N System technical support documentation for CSM 101.

- Addition 1: Paragraph 6.2.7.2.7. Add the following:
During this 12 minute period monitor IG TORQUE MOTOR CURRENT (CG 2120) on the CRT. This measurement shall not exceed 0.125 amp.
- Addition 2: Paragraph 6.2.7.3.5. Add the following:
During this 12 minute period monitor OG TORQUE MOTOR CURRENT (CG 2180) on the CRT. This measurement shall not exceed 0.125 amp.
- Addition 3: Paragraph 6.2.7.4.5. Add the following:
During this 5 minute period monitor MG TORQUE MOTOR CURRENT (CG 2150) on the CRT. This measurement shall not exceed 0.125 amp.
- Addition 4: Add paragraph 6.2.4.14 to read as follows: (Add the IMU HFR 6.2.4.14 On the Event Recorder verify that the IMU HFR Current discrete (CG2302) and IMU Blower current discrete (CG 2303) are ON (may cycle OFF momentarily.)
- Addition 5: Paragraph 6.2.13.6. Add the following step prior to 6.2.13.6:
During the Trunnion Slew Rate Test HI Speed (6.2.13.6) monitor and verify the following signals on the CRT.
- | Signal | Requirement |
|------------------------------------|-----------------|
| a. SXT TRUNNION TACH O/P (CG 3150) | 3.3±1.3 VRMS |
| b. SCT TRUNNION TACH O/P (CG 3170) | -0.85±0.35 VRMS |
- Addition 6: Paragraph 6.2.13.9. Add the following step prior to 6.2.13.9:
During the Shaft Slew Rate Test - HI speed (6.2.13.9) monitor and verify the following signals on the CRT.
- | Signal | Requirement |
|---------------------------------|---------------|
| a. SXT SHAFT TACH O/P (CG 3140) | 3.3±1.3 VRMS |
| b. SCT SHAFT TACH O/P (CG 3160) | -3.3±1.3 VRMS |
- Addition 7: Paragraph 6.2.13.18. Add the following step prior to 6.2.13.18:
During the Trunnion Slew Rate Test LO Speed monitor and verify the following signal on the CRT.
- | Signal | Requirement |
|--------------------------------------|----------------|
| a. TRUNNION CDU FINE ERROR (CG 3011) | ±.07 VRMS MAX. |

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Addition 8: Paragraph 6.2.13.21. Add the following step prior to 6.2.13.21:
During the Shaft Slew Rate Test LO Speed Monitor and verify the following
signal on the CRT.

Signal	Requirement
a. SHAFT CDU FINE ERROR (CG 3021)	±.07 VRMS MAX

Addition 9: Paragraph 6.1.2.1. Add new paragraph 6.1.2.1.5 as follows:
Data from the on board tape recorder shall be made available and the
following signals verified.

- a. VIB NB ROLL (CG 6001)
- b. VIB NB PITCH (CG 6002)
- c. VIB NB YAW (CG 6003)

Addition 10: Paragraph 6.2.1.5.6, add to the first sentence the following:

"....PIPA TEMP (CG 2300) and IRIG TEMP (CG 2301) on the CRT."

Paragraph 6.2.3.1, add 6.2.3.1.13 as follows:

"30 minutes after the application of IMU OPERATE power record IRIG TEMP
(CG 2301) displayed on the CRT"

Paragraph 6.2.3.1.14, add to the first sentence the following:

"....PIPA TEMP (CG 2300) and IRIG TEMP (CG 2301 every...."

Paragraph 6.2.3.1.15 change to read as follows:

"When 2 hours have elapsed since the application of IMU OPERATE power
record PIPA TEMP and IRIG TEMP. PIPA TEMP shall be $130.5^{\circ} \pm 1.5^{\circ}F$.
IRIG TEMP shall be $135^{\circ} \pm 2.5^{\circ}F$. PIPA TEMP shall be within $0.5^{\circ}F$ of that
recorded in 6.2.3.1.12 and 6.2.1.5.4. IRIG TEMP shall be within $0.5^{\circ}F$ of
that recorded in 6.2.3.1.13".

Paragraph 6.2.5.2.16 Add the following to Table VI:

"14 CG 2301. IRIG TEMPERATURE"

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ADDENDUM II

Scope: The following changes are required to make ND1002325 applicable as G&N System technical support documentation for systems containing SUNDIAL C test ropes. Refer to Drawing 2014999 to define further which test ropes and jumper modules shall be installed.

- Change 1:** Paragraphs 6.2.9.1.4, 6.2.9.2a, 6.2.9.3a, 6.2.9.5a, 6.2.9.6a, 6.2.9.7a, 6.2.9.8, 6.2.9.10a, 6.2.9.11a, 6.2.9.13a, 6.2.9.15a, 6.2.9.16a, 6.2.9.22. In each of these paragraphs change "VERB 06 NOUN XX flashing" to "VERB 33 NOUN XX flashing."
- Change 2:** Paragraphs 6.2.21.2.2a, 6.2.21.2.4a, 6.2.21.2.7a, 6.2.21.2.10a, 6.2.21.2.13a, 6.2.21.2.16a, 6.2.21.2.19a, 6.2.21.2.22a, 6.2.21.2.25a, 6.2.21.2.28a, 6.2.21.2.31a, 6.2.21.2.34a, 6.2.21.2.37a, 6.2.21.3.8a, 6.2.21.3.11a, 6.2.21.3.14a, 6.2.21.3.17a, 6.2.21.3.20a, 6.2.21.3.24a, 6.2.21.3.27a, 6.2.21.3.31a, 6.2.21.3.34a, 6.2.21.3.37a, 6.2.21.3.40a, In each of these steps change "V06" to "V33".
- Change 3:** Paragraph 6.2.16.7.19 Change FROM: On K-148 enter the following sequence:
- | | | |
|---------|---------|------|
| VERB 21 | NOUN 01 | ENTR |
| 00407 | | ENTR |
| 77757 | | ENTR |
| VERB 21 | NOUN 01 | ENTR |
| 00411 | | ENTR |
| 00020 | | ENTR |
| VERB 33 | | ENTR |
- Change TO: On K-148 enter the following sequence:
- | | | |
|---------|---------|------|
| VERB 21 | NOUN 01 | ENTR |
| 02502 | | ENTR |
| 77757 | | ENTR |
| VERB 21 | NOUN 01 | ENTR |
| 02504 | | ENTR |
| 00020 | | ENTR |
| VERB 33 | | ENTR |
- Change 4:** Paragraph 6.2.16.7.33 Change FROM: On K-148 enter the following sequence:
- | | | |
|---------|---------|------|
| VERB 21 | NOUN 01 | ENTR |
| 00405 | | ENTR |
| 00020 | | ENTR |
| VERB 21 | NOUN 01 | ENTR |
| 00407 | | ENTR |
| 77757 | | ENTR |
| VERB 33 | | ENTR |

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ADDENDUM II

Change 4
(Continued)

Change TO: On K-148 enter the following sequence:

VERB 21	NOUN 01	ENTR
02500		ENTR
00020		ENTR
VERB 21	NOUN 01	ENTR
02502		ENTR
77757		ENTR
VERB 33		ENTR

POST INSTALLATION CHECKOUT PROCESS
 SPECIFICATION FOR THE APOLLO GUIDANCE
 AND NAVIGATION SYSTEM - BLOCK II

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
12/21/87	G	35343	28, 33, 48, 50, 54	EA <i>SH/SC</i>	—

This specification consists of page 1 to 134 including Appendix I pages 129-130, and Addendum I, pages 131 and 132 and Addendum II, pages 133 and 134.

APPROVALS	Not required per CCA-497- 0274				R. D. Petryk	D. A. Ziemer
	NASA/MSC		MIT/IL			AC:

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6.2.1.4.9 Deleted: CMC ~~is to be~~ summary by entering the following sequence into ~~the K-start~~

- ~~a. VERB 21, ENTER~~
- ~~b. 0000, ENTER~~

6.2.1.4.10 Initiate CMC self-check by entering the following sequence into the K-start:

- a. VERB 21, NOUN 27 ENTER
- b. 77777, ENTER
- c. VERB 15 NOUN 01 ENTER
- d. 1366, ENTER

6.2.1.4.10.1 Monitor DSKY until R3 (SCOUNT +2) increments twice. If an error is detected, the following will be displayed:

- a. VERB 05 NOUN 31
- b. R1 = 01102
- c. R2 = XXXXX C (SFALL)
- d. R3 = XXXXX C (ERCOUNT)

6.2.1.4.10.2 Enter the following into the K-start:

- a. VERB 21
- b. NOUN 27, press ENTER pushbutton
- c. 00000, press ENTER pushbutton

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6.2.2.6 Parity Fail Test

6.2.2.6.1 Enter the following into the K-Start. Press the ENTER pushbutton after each entry.

- a. VERB 21 NOUN 02, ENTER
- b. 01600, ENTER
- c. 33777, ENTER
- d. VERB 25 NOUN 26, ENTER
- e. 04000, ENTER
- f. 01600, ENTER
- g. 00003, ENTER
- h. VERB 30, ENTER

The RESTART lamps on the MDC & LES DSKY's shall illuminate. The PONS caution lamps on the MDC & LES annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LES CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.6.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PONS caution lamps shall extinguish.

6.2.2.6.3 Enter VERB 36, into the K-START. Press the ENTER pushbutton.

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6.2.5 General Turn Off and Turn On Procedure

NOTE: This procedure shall be utilized any time after performing 6.1.3 Prepower Application Requirements, 6.2.1, Standby Power On Test, and 6.2.3. Operate Power on Test, to turn on or turn off the G&N System. Appropriate portions of this procedure will be referenced in other tests.

6.2.5.1 Turn Off Procedure

CAUTION: This procedure must be performed in the sequence specified. Failure to adhere to this sequence may require calibration of the inertial components.

6.2.5.1.1 Enter the following sequence into the K-148.

- a. VERB 41 NOUN 20, ENTER
- b. +00000 ENTR
- c. +00000 ENTR
- d. +09000 ENTR

Verify that the GIMBAL LOCK indicator on the DSKY's is illuminated.

6.2.5.1.2 Set the following switches on the G&N Indicator Control Panel to the positions designated.

- a. OPTICS MODE to MANUAL
- b. CONTROLLER MODE to DIRECT
- c. CONTROLLER SPEED to LO
- d. TELESCOPE TRUNNION to SLAVE TO EXT
- e. RETICLE BRIGHTNESS to minimum brightness position

6.2.5.1.3 Set the G/N Power - IMU switch on the LEB Lighting Control Panel to OFF and G&N IMU MN A and MN B circuit breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).

6.2.5.1.3.1 On K-148 enter the following:

VERB 21 NOUN 01 ENTR
00034 ENTR
00000 ENTR
Gimbal Lock and PGNS CAUTION lamp shall extinguish
Press ENTR
00322 ENTR
40000 ENTR
The NO ATT lamp shall extinguish.

6.2.5.1.4 Decrease the LIGHTS - NUMERICS controls on both the Left Hand Circuit Breaker panel and the LEB Lighting Control Panel to the minimum brightness - OFF position.

6.2.5.1.5 Set the PSAAM power switch on the PSAAM of OFF.

6.2.5.1.6 Set the IMU HTR MN A and MN B circuit breaker on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).

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- 6.2.5.2.3 Energize the GAN COMPUTER MNA and MNB breakers on the Right Hand Circuit Breaker panel (Breakers pushed in). Enter VERB 61 into KI46 and press the ENTER pushbutton. Verify +14 and +4 VDC CMC power supply outputs on CBT display. Voltages shall be +14, 0±0.4 VDC (CG 1049) and +4, 0±0.2 VDC (CG 1049). Verify +14 and +4 VDC CMC power supply outputs on NOTES. Restart Lamp only. Illuminates at 1.6 amps, (disregard and press 2 VDC (CG 1049) RESET on the DSKY.
- 6.2.5.2.4 Energize the GAN DMU HTR MNA and MNB breakers on the Right Hand Circuit Breaker panel (breakers pushed in). Insure that the CMC +28 VDC discrete lamp on the Event Module is illuminated (CG 1523).
- 6.2.5.2.5 Set the GAN POWER AC1 and AC3 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in). Set the GAN POWER AC1-OFF-AC3 switch to AC1.
- 6.2.5.2.5.1 Set the GAN DSKY and Display Panel brightness to the minimum acceptable level by manipulation of LIGHTS - NUMERICS control on both Left Hand circuit breaker panel and LEB light Control panel.
- 6.2.5.2.5.2 Set/Verify the following switches on the PSAAM.
- PSAAM POWER to ON
 - INHIBIT VOLTAGE FAIL to OFF.
- 6.2.5.2.6 Disregard all alarm indications on the CMC DSKY panels. Enter VERB 36 into KI46. Press ENTER pushbutton. Press ERROR RESET pushbutton on K-Start. All computer alarms except the Gimbal Lock Indicator on the Main Display Console (MDC) and LEB AGC DSKY shall clear. Verify registers R1, R2, and R3 on the DSKY's are cleared.
- 6.2.5.2.7 ~~Deleted: CMC erasable memory by entering the following sequence into the K-Start: a. VERB 47, press ENTER b. 00016, press ENTER.~~
- 6.2.5.2.8 Initiate CMC Self-Test by entering the following into the K-Start:
- VERB 21 NOUN 27, ENTER
 - 77777, ENTER
 - VERB 15 NOUN 01, ENTER
 - 01366, ENTER
- 6.2.5.2.8.1 Monitor DSKY until R3 (SCOUNT+2) increments twice. If an error is detected, the following will be displayed:
- VERB 06 NOUN 31
 - R1 = 01102
 - R2 = XXXXX c (RFAIL)
 - R3 = XXXXX c (RRCOUNT)
- 6.2.5.2.8.2 Terminate Self-Test by entering the following into the K-Start:
- VERB 21 NOUN 27, ENTER
 - 00000, ENTER

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- 6.2.5.3.5 Enter the following into K148:
- a. VERB 41 NOUN 20, ENTER
 - b. +00000, ENTER
 - c. +00000, ENTER
 - d. +00000, ENTER
- Observe the NO ATT lamp lights and the Inner, Outer, and Middle Gimbal angles are 0±1.5° as indicated by the CDUX, CDUY, and CDUZ displays on the CRT.
- 6.2.5.3.6 Insure that the following switches are set to the positions indicated.
- a. CONTROLLER COUPLING to DIRECT
 - b. OPTICS MODE to MAN
 - c. TELESCOPE TRUNNION to SLAVE TO SXT
 - d. TRACKER to OFF
 - e. CONTROLLER SPEED to LO
 - f. CONDITION LAMPS to ON
 - g. UP TELEMETRY to ACCEPT
- 6.2.5.3.7 ~~Deleted. ENTER REPT push button. Enter the following into K148.~~
- ~~a. VERB 57, ENTER~~
 - ~~b. 00015, ENTER~~
- 6.2.6 G&N Operational Test
- 6.2.6.1 Initial Conditions
- Proceed with this test if the Operate Power On Test of 6.2.3 or the Turn on Procedure of 6.2.5 has been completed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding.
- 6.2.6.1.1 Enter the following into K-148:
- a. VERB 01 NOUN 10, ENTER
 - b. 00003, ENTER
- Record R1 = AAAAA and the time of day
- 6.2.6.1.2 Enter the following into K-148.
- a. VERB 21 NOUN 02, ENTER
 - b. 01300, ENTER
 - c. AAAAA, ENTER (from 6.2.6.1.1)
 - d. VERB 06 NOUN 02, ENTER
 - e. 01300, ENTER
- Record R1 = BBBBB
- 6.2.6.1.3 Perform the following calculations:
- a. $R1 (BBBBB) \times 5.12 = CC.C$ (hours in high order scaler Channel 03)
3600

APOLLO G&N Specification
 ND 1002325 REV H
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POST INSTALLATION CHECKOUT PROCESS
 SPECIFICATION FOR THE APOLLO GUIDANCE
 AND NAVIGATION SYSTEM - BLOCK II

Record of Revisions

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				AC	NASA
12/21/87	G	35343	26, 33, 48, 50, 54	EA <i>SH/AC</i>	—
2/28/68	H	35700	3, 4, 8, 11-13, 17, 21, 23, 25-27,	EA	WLS
			30-33, 38, 40-42, 47-51, 54, 61		
			62, 69-134: was 134 pages.		
			now 158 pages. <i>SH/AC</i>		

This specification consists of pages I to 158 including Appendix I, pages 132-133, and Addendum I, pages 134-155, Addendum II, pages 156-157 and Addendum III, page 158.

APPROVALS	Not required per CCA-497- 0274	MIT/IL	R. D. Petryk	D. A. Ziemer
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			AC	

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5.4 Test Sequence

- 5.4.1 The test sequence normally should follow the flow outlined by Figure 1 in the order specified except 6.2.5. Turn On and Turn Off procedure, which may be performed as the requirement arises.

TABLE I G&N TESTS

Paragraph No.

6.1.3	Prepower Application Tests (Part of G&N Installation OCP)
6.2.1	Application of Standby Power to G&N System
6.2.2	CMC Operational Test
6.2.3	Operate Power On Test
6.2.4	G&N Power Supplies Test
6.2.5	General Turn Off and Turn On Procedure
6.2.6	G&N Operational Test
6.2.7	Gimbal Friction Test
6.2.8	G&N Panel Brightness & Lamp Test
6.2.9	Semi-Automatic Mode Control Test
6.2.10	Zero Optics Test
6.2.11	Optics Coordinate Transformation Control Test
6.2.12	Optics Functional Test
6.2.13	Optics Slew Rate Test
6.2.14	Stabilization Loop Step Response Test
6.2.15	IRIG Scale Factor Test
6.2.16	IMU Performance Test
6.2.17	Fine Alignment Test SXT-NB-IMU
6.2.18	Gyrocompassing Test
6.2.19	Voltage Margin Test
6.2.20	S/C Control & Display Test

- Perform steps 11 to 20 once before proceeding.

A On K-148 enter the following

VR5

100000
100000

[illegible]

000000+

10000+

Where X is the test position number represented in DDTY Row 3 display.

3 When VIMS 06 RCU 66 flashes do not record test results.

TABLE 1

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TABLE 2

O. O. S. PARAMETER	PERFORM POSITIONS	PARAMETERS TO BE REQUALIFIED
NBDY	1	NBDY
NBDZ	2	NBDZ
NBDX	3	NBDX
ADSRAY	1 and 4	ADSRAY, NBDY
ADSRAX	2 and 9	ADSRAX, NBDZ
ADSRAX	3 and 7	ADSRAX, NBDX
ADIAZ	1 thru 3, 7 and 10	NBDY, NBDX, ADIAZ, ADSRAX, ADIAZ,
ADIAZ	2 thru 4	NBDZ, NBDX, ADIAZ
ADIAZ	1 thru 3	NBDX, ADIAZ, NBDY, NBDZ
X PIPA Bias S. F.	1 thru 2	X PIPA BIAS, X PIPA S. F.
Y PIPA Bias S. F.	5 and 6	Y PIPA BIAS Y PIPA S. F.
Z PIPA Bias or S. F.	3 and 4	Z PIPA BIAS Z PIPA S. F.

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Paragraph Number	Test Title	DMU	NAV BASE	OPTICS	CMG	PSA	LEB DSKY	MDC DSKY	SIGN COND	GDU	G&N HARNESS	PIPA ELECT.	INDICATOR CONTROL PANEL
6.1.3	Pre-Power Application Tests	X	X	X	X	X	X	X	X	X	X	X	X
6.2.1	Application of Standby Power to G&N System	X	X	X	X	X	X	X	X	X	X	X	X
6.2.5	General Turn OFF and Turn ON Procedure	X	X	X	X	X	X	X	X	X	X	X	X
6.2.3	Operate Power On Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.2	CMG Operational Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.8	G&N Panel Brightness and Lamp Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.6	G&N Operational Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.10	Zero Optics Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.13	Optics Slow Rate Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.11	Optics Coordinate Transformation Control	X	X	X	X	X	X	X	X	X	X	X	X
6.2.12	Optics Functional Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.9	Semi-Automatic Mode Control Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.14	Stab Loop Step Response Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.15	IRIG Scale Factor Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.16	IMU Performance Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.17	Fuse Alignment Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.19	Voltage Margin Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.7	Gimbal Friction Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.18	Gyrocompassing Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.4	G&N Power Supplies Test	X	X	X	X	X	X	X	X	X	X	X	X
6.2.20	Spacecraft Control and Displays Test	X	X	X	X	X	X	X	X	X	X	X	X

* To be used as necessary to turn system on and off.

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- 6.1.1.5 A warmup period of 1 hour with OPERATE power applied shall be required prior to performing any test in which gyro and accelerometer parameters are measured, and 15 minutes warmup prior to any test in which precision amplitude and frequency power supply checks are made.
- 6.1.1.6 The following Command Module switches shall be in the position shown unless specifically directed otherwise in a procedural function.
- UP TLM switches on the LEB G&N Control Panel and MDC Panel 2 shall be set to ACCEPT.
 - LAUNCH VEHICLE - GUIDANCE switch on MDC Panel 2 shall be set to IU.
 - The SC CONT switch on MDC Panel 1 shall be set to CMC.
 - The CMC MODE switch on MDC Panel 1 shall be set to AUTO.
 - The ΔV CG switch on MDC Panel 1 shall be set to CSM.
 - The LIGHTS-INTEGRAL control on the LEB Lighting Control Panel and the Left Hand Circuit Breaker panel shall be set to the minimum brightness - OFF position.
- 6.1.2 The following optical reference alignment requirements shall be demonstrated.
- 6.1.2.1 G&N Installation Qualification Fixture
- 6.1.2.1.1 The SXT Optical Reference No. 1 (Azimuth Autoset) LOS shall be located approximately 40 degrees (CW when viewed from above) from the SCZ axis measured in a horizontal plane. At this position, the Optical Reference shall be capable of being viewed through the SXT ST LOS.
- 6.1.2.1.2 The SXT Optical Reference LOS position with respect to the horizontal plane shall be known to within 5 arc-seconds. The azimuth bearing of the Optical Reference LOS shall be known to within ± 30 minutes of arc.
- 6.1.2.1.3 The SXT Optical Reference No. 2 LOS shall be located approximately 80 degrees from the SXT Optical Reference No. 1 (40 degrees from S/C Z axis) measured in a horizontal plane. At this position, the Optical Reference shall be capable of being viewed through the SXT STAR LOS.

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6.1.3.3 Polarity and Voltage Check on S/C Power

6.1.3.3.1 Perform a voltage and polarity check of the G&N S/C power by performing the measurements indicated in Table II. Set the following switches to the position indicated.

- G/N POWER-OPTICS switch on the LEB Lighting Control Panel to ON.
- G/N POWER - IMU switch on the LEB Lighting Control Panel to ON.
- G/N POWER switch on the Right Hand Circuit Breaker Panel to AC1.

For each measurement in Table II set the indicated circuit breaker on the Right Hand Circuit Breaker Panel to ON (breaker pushed in). After each measurement return the circuit breaker to OFF (breaker pulled out).

TABLE II. POLARITY & VOLTAGE REQUIREMENTS
FOR S/C POWER.

Test No.	Circuit Breaker	Polarity & Connector		Requirements
		Pin No.		
		Low	High	
1	COMPUTER MN A	P1-1	P1-2	+28.8 + 3VDC
2	OPTICS MN A	P1-14	P1-7	+28.8 + 3VDC
3	IMU MN A	P1-15	P1-9	+28.8 + 3VDC
		P1-16	P1-10	+28.8 + 3VDC
4	IMU HTR MN A	P1-3	P1-8	+28.8 + 3VDC
5	COMPUTER MN B	P2-1	P2-2	+28.8 + 3VDC
6	OPTICS MN B	P2-14	P2-7	+28.8 + 3VDC
7	IMU MN B	P2-15	P2-9	+28.8 + 3VDC
		P2-16	P2-10	+28.8 + 3VDC
8	IMU HTR MN B	P2-3	P2-8	+28.8 + 3VDC
9	POWER AC 1	P1-18	P1-17	115 + 4 VAC 400 + 7 cps
Set G/N POWER switch on the Right Hand Circuit Breaker Panel to AC 2.				
10	POWER AC 2	P1-18	P1-17	115 + 4 VAC 400 + 7 cps

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TABLE III. RESISTANCE REQUIREMENTS FOR G&N
POWER CONNECTORS

Test No.	From	To	Requirements (ohms)	Results
1	J1-15	J1-6	1000 to infinity	
2	J1-15	J1-14	1000 to infinity	
3	J1-15	J1-1	1000 to infinity	
4	J1-15	J1-18	5 meg to infinity	
5	J1-15	J1-16	0.0 to 0.5	
6	J1-15	J1-3	0.0 to 0.5	
7	J1-15	J2-15	0.0 to 0.5	
8	J1-14	J2-14	0.0 to 0.5	
9	J1-1	J2-1	0.0 to 0.5	
10	J1-6	J2-6	0.0 to 0.5	
11	J1-16	J2-16	0.0 to 0.5	
12	J1-3	J2-3	0.0 to 0.5	
13	J1-14	J1-6	1000 to infinity	
14	J1-1	J1-14	1000 to infinity	
15	J1-1	J1-6	0.0 to 2.0 infinity	
16	J1-18	J1-6	5 meg to infinity	
17	J1-18	J1-14	5 meg to infinity	
18	J1-18	J1-1	5 meg to infinity	
19	J1-2	J1-1	2.8 to infinity	
20	J1-9	J1-15	1.1 to infinity	
21	J1-10	J1-16	1.1 to infinity	
22	J1-7	J1-14	2.8 to infinity	
23	J1-8	J1-3	3.7 to infinity	
24	J1-17	J1-18	5 to 20	
25	J2-2	J2-1	2.8 to infinity	
26	J2-9	J2-15	1.1 to infinity	
27	J2-10	J2-16	1.1 to infinity	
28	J2-7	J2-14	2.8 to infinity	
29	J2-8	J2-3	3.7 to infinity	

6.1.3.5 Disconnect the test cable connectors J1 and J2 from G&N power connectors 56P30 and 56P31, respectively. Mate G&N connector 56P30 to S/C connector C03WLJ345 and mate G&N connector 56P31 to S/C connector C03WLJ346. Mate G&N connector 56P32 to S/C connector C03WLJ347.

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6.2 Test Procedures

6.2.1 Application of Standby Power to G&N System

- 6.2.1.1 Verify that spacecraft power checks, to include polarity and magnitude on Spacecraft Power Connector, have been made as specified in 6.1.3.
- 6.2.1.2 All power and control switches on the G&N Indicator Control Panel shall be placed in the OFF or neutral position.
- 6.2.1.3 The Inertial Component Temperature Controller (ICTC) shall be supplying inertial component heater power to the G&N System through the PSA, Connector No. 45J2.

6.2.1.4 Computer Power On

- 6.2.1.4.1 Set G&N COMPUTER MN A and MN B Breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in).

NOTE: Restart Lamp may illuminate, if it does, disregard and press RSET on the DSKY.

- 6.2.1.4.2 Set the POWER-AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in), and position G/N POWER switch to AC1.
- 6.2.1.4.3 Set the computer numerical display lights to the minimum acceptable brightness by rotating the BRIGHTNESS Controls on the MDC and LEB Lighting Control Panels.
- 6.2.1.4.4 The +28 VDC CMC OPERATE voltage (CG 1520) shall be $+28.6 \pm 3$ VDC. Verify CRT indication. On DSKY verify TEMP light is ON. On the G&N Indicator Control Panel verify PGNS light is ON.
- 6.2.1.4.5 Using DSKY, enter VERB 36, ENTR, then press RESET. Verify that R1, R2, and R3 are blank and PROG = 00.00, LEB CMC BASIN and CRT shall read.
- 6.2.1.4.6 The voltage output of the +4 VDC CMC supply shall be $+4.00 \pm 0.20$ VDC (CG 1030). The value on the CRT shall be recorded.
- 6.2.1.4.7 The voltage output of the +14 VDC CMC supply shall be $+14.0 \pm 0.4$ VDC, (CG 1020). The value on the CRT shall be recorded.
- 6.2.1.4.8 Verify that the CMC is in the Backup Mode by monitoring on the CRT that the Program indicates 00, and the Program readouts on the MDC and LEB AGC DSKY indicate 00.

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- 6.2.1.4.9 Deleted: ~~_____~~
~~_____~~
~~_____~~
- 6.2.1.4.10 Initiate CMC self-check by entering the following sequence into the K-start:
- a. VERB 21, NOUN 27 ENTER
 - b. 77777, ENTER
 - c. VERB 16 NOUN 01 ENTER
 - d. 1366, ENTER
- 6.2.1.4.10.1 Monitor DSKY until R3 (SCOUNT +2) increments twice. If an error is detected, the following will be displayed:
- a. VERB 05 NOUN 31
 - b. R1 - 01102
 - c. R2 - XXXXX C (SFALL)
 - d. R3 - XXXXX C (RRCOUNT)
- 6.2.1.4.10.2 Terminate the monitor routine by entering the following into the DSKY:
- a. VERB 34, ENTER.
 - b. NOUN 27, press ENTER pushbutton
- 6.2.1.4.10.3 Enter the following into the K-start:
- a. VERB 21
 - b. NOUN 27, press ENTER pushbutton
 - c. 00000, press ENTER pushbutton

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6.2.1.5 IMU HTR Heater Power On

6.2.1.5.1 Enter the IMU Standby Mode of operation by engaging the IMU HTR MN A and MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).

6.2.1.5.2 Verify that the IMU +28 VDC STANDBY discrete lamp on Event Module is illuminated (CG 1513). On DSKY verify TEMP light is extinguished. On the G&N Indicator Control Panel verify PGNS light is extinguished.

6.2.1.5.3 Record the value of the following signals displayed on the CRT.

Signal	Requirement
a. CG 1331 28V 3200 CPS POWER SUPPLY FEEDBACK	28.6±0.6 VRMS
b. CG 1510 + 28 VDC STANDBY POWER	28.8 (±3) VDC

6.2.1.5.4 30 minutes after entering the IMU Standby Mode start recording PIPA TEMP every 5 minutes until the PIPA temperature is stabilized. The PIPA temperature shall be considered stabilized when the temperature change is less than 0.1 deg for 30 minutes. Record the PIPA Standby Mode stabilized temperature.

6.2.1.5.5 Deleted

6.2.1.5.6 On the Event Recorder, verify that the IMU HEATER Current discrete (CG 2302) is ON and that the IMU BLOWER Current discrete (CG 2303) is OFF over the PIPA Standby Temperature stabilization period (occasionally discretes may cycle.)

6.2.1.5.7 With the eyepiece in the Eyepiece Storage Unit, check the eyepiece surface temperature at the quick disconnect flange using an L&N #8693 Temperature Potentiometer, or a similar type thermocouple probe meter. Record both the ambient and eyepiece surface temperatures and verify that the eyepiece surface temperature is at least 10°F above the ambient temperature.

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6.2.2.4 DSKY Pushbutton Check

6.2.2.4.1 Enter the following sequence into the LEB CMC DSKY. Press the ENTER pushbutton after each entry (denoted by E).

- a. VERB 25 NOUN 01, E
- b. 01600, E
- c. +00123, E
- d. -00456, E
- e. -00789, E

6.2.2.4.2 The LEB CMC DSKY shall indicate +00123 in R1, -00456 in R2, and -00789 in R3.

6.2.2.4.3 Enter VERB 05, NOUN 01 into the LEB CMC DSKY. Press the ENTER pushbutton.

6.2.2.4.4 Enter 01600 into LEB CMC DSKY. Press the ENTER pushbutton. The LEB CMC DSKY shall indicate 00024 in R1, 77664 in R2, and 77576 in R3. Verify.

6.2.2.4.5 Enter the following sequence into the LEB CMC DSKY. The results shall be as indicated in 6.2.2.4.6.

- a) VERB 21 NOUN 01, ENTER
- b) 01800, ENTER
- c) +00123, DO NOT Press ENTER

6.2.2.4.5.1 Press the CLEAR pushbutton. R1 shall clear.

6.2.2.4.6 Enter 8 into the LEB CMC DSKY. Do not press ENTER. The Operator Error Light shall light. Error Light shall light.

6.2.2.4.6.1 Press the RESET pushbutton. The Operator Error light shall extinguish.

6.2.2.4.7 Enter the following sequence into the LEB CMC DSKY. Press the ENTER pushbutton as indicated. The KEY Release Light shall light.

- a) VERB 16, NOUN 20, ENTER
- b) VERB

6.2.2.4.7.1 Press the KEY RELEASE pushbutton. The Key Release Light shall extinguish.

6.2.2.4.7.2 Enter VERB 36, into the LEB CMC DSKY. Press the ENTER pushbutton.

NOTE: 6.2.2.4.8 does not apply to 2TV-1.

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- 6.2.2.4.0** Enter the following sequence into the LEB CMC DSKY to check the proceed interface of the STBY pushbutton.
- a) VERB 11 NOUN 10, ENTER
 - b) 00032, ENTER
- Verify R1 = 7XXXX. Press and hold the STBY pushbutton and verify 5XXXX displayed in R3. Release the STBY pushbutton once and verify that "5XXXX" is displayed. Release the STBY pushbutton and verify 7XXXX displayed in R1. Enter VERB 34 and press the ENTER pushbutton.
- 6.2.2.4.0** Repeat of 6.2.2.4.1 through 6.2.2.4.2, using the MDC CMC DSKY. The results shall be as specified in 6.2.2.4.2.
- 6.2.2.5** Uplink and Downlink Checks.
- 6.2.2.5.1** Enter VERB 36 into K148. Press the ENTER pushbutton, then press ERROR RESET pushbutton.
- 6.2.2.5.2** Enter the following sequence into K148. Press the ENTER pushbutton after each entry.
- a. VERB 26 NOUN 01 ENTER
 - b. 01600, ENTER
 - c. 00000, ENTER
 - d. 77777, ENTER
 - e. 07254, ENTER
 - f. VERB 05 NOUN 01, ENTER
 - g. 01600, ENTER
- 6.2.2.5.3** CMC Registers R1, R2, and R3 display on the CRT shall indicate 00000, 77777, and 07254, respectively.
- 6.2.2.5.4** Set/verify that the UP TLM switch on the Main Display Panel is set to ACCEPT and that the UP TLM switch on the G&N Control Panel is set to BLOCK.
- Verify that the BLOCK UPLINK discrete is ON. CRT is ON.
- 6.2.2.5.5** Execute the Block Uplink Override R-START to enable data to be sent via K-START. On K-148 insert VERB. Verify that the VERB indication on the DSKY and CRT does not change. On the DSKY and CRT does not change.
- 6.2.2.5.6** Set the UP TLM switch on the G&N Indicator Control Panel to ACCEPT. Verify that the BLOCK UPLINK discrete is OFF. CRT is OFF.
- 6.2.2.5.7** On K-148 insert VERB 01. Verify that the VERB indication on the DSKY and CRT is 01.

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- 6.2.2.5.8 Set the UP TLM switch on the MAIN DISPLAY Panel to BLOCK. Verify that the BLOCK UPLINK discrete is ON, CRT is ON.
- 6.2.2.5.9 On K-148 insert VERB. Verify VERB indication on the DSKY and CRT does not change.
- 6.2.2.5.10 Set the UP TLM switch on the MAIN DISPLAY Panel to ACCEPT. Verify that the BLOCK UPLINK discrete is OFF. Release the Block Uplink Override R-START.
- 6.2.2.5.11 On K-148 insert VERB 36. Press the ENTER pushbutton.

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6.2.2.6 Parity Fail Test

6.2.2.6.1 Enter the following into the K-Start. Press the ENTER pushbutton after each entry.

- a. VERB 22, NOUN 02, ENTER
- b. 01600, ENTER
- c. 33777, ENTER
- d. 04353 ENTER
- e. VERB 25 NOUN 26, ENTER
- f. 04000, ENTER
- g. 01600, ENTER
- h. 00003, ENTER
- i. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.6.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.6.3 Enter VERB 36, into the K-START. Press the ENTER pushbutton.

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- 6.2.2.11 Mark and Mark Reject pushbutton test.
- 6.2.2.11.1 On the G&N Indicator Control panel press and hold MARK pushbutton.
- 6.2.2.11.2 On the DSKY observe
VERB 11 NOUN 31
ROW 1 = 00114
Prog Alarm lamp is lighted
Press F12 RSET
- 6.2.2.11.3 Enter the following on K-148.
VERB 11 NOUN 10 ENTER
00016 ENTR
- 6.2.2.11.4 Observe that DSKY Row 1 displays 00040.
- 6.2.2.11.5 Release MARK pushbutton
- 6.2.2.11.6 Observe that DSKY Row 1 displays 00000.
- 6.2.2.11.7 Press and hold the REJECT pushbutton on the G&N Indicator Control Panel.
- 6.2.2.11.8 On the DSKY observe
VERB 05 NOUN 31
ROW 1 = 00112
Prog Alarm lamp is lighted
Press ERR RSET
- 6.2.2.11.9 Observe that DSKY Row 1 displays 00100.
- 6.2.2.11.10 Release the REJECT pushbutton.
- 6.2.2.11.11 Observe that DSKY Row 1 displays 00000.
- 6.2.2.11.12 On the DSKY Perform the following operation:
VERB 36 ENTR
- 6.2.2.12 Minimum Impulse Controller Input Test
- 6.2.2.12.1 Enter the following into the DSKY.
a. VERB 11 NOUN 10, ENTR
b. 00032, ENTR
- 6.2.2.12.2 Set the Minimum Impulse Controller on the Indicator Control Panel to the following position and observe R1 of the DSKY for the proper indications.
- | <u>MIC Position</u> | <u>R1 DSKY Indication</u> |
|---------------------|---------------------------|
| a. Up | 77775 |
| b. Down | 77776 |
| c. Left | 77737 |
| d. Right | 77757 |

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6.2.3 Operate Power On Test

6.2.3.1 IMU Operate Power ON

CAUTION: The sequences specified in this test must be adhered to. Deviations may necessitate recalibration of the inertial components.

NOTE: Disregard the GIMBAL LOCK indicator until the completion of step 6.2.3.1.6.

6.2.3.1.1 The following Command Module switches and circuit breakers shall be in the following state:

Right Hand Circuit Breaker Panel

- a. GUIDANCE/NAVIGATION COMPUTER MN A and MN B breakers on (Pushed in)
- b. GUIDANCE/NAVIGATION IMU HTR MN A and MN B breakers on (pushed in)
- c. GUIDANCE/NAVIGATION IMU MN A and MN B breakers off (pulled out)
- d. GUIDANCE/NAVIGATION OPTICS MN A and MN B breakers off (pulled out)

LEB Lighting Control Panel

- e. G/N Power - IMU set to OFF
- f. G/N Power - Optics set to OFF

6.2.3.1.2 Switches and selectors on the G&N Indicator Control Panel shall be set as follows:

- a. OPTICS ZERO to ZERO
- b. OPTICS MODE TO MAN
- c. OPTICS COUPLING TO DIRECT
- d. OPTICS SPEED to MED
- e. OPTICS TEL TRUN to SLAVE to SXT
- f. RETICLE BRIGHTNESS to minimum brightness position.

6.2.3.1.3 Adjust the Command Module MDC and LEB Lighting Controls to minimum intensity for proper readout of G&N displays.

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6.2.3.1.4 Set up the ACE analog recorders to monitor the following measurements (set chart speed to 5 mm/sec):

- CG 2117 IGA Servo Error In Phase
- CG 2177 OGA Servo Error In Phase
- CG 2147 MGA Servo Error In Phase
- CG 2112 IG IX Resolver Output Sin
- CG 2172 OG IX Resolver Output Sin
- CG 2142 MG IX Resolver Output Sin
- CG 1040 +120 VDC PIPA Supply DC Level

CAUTION: Before proceeding, insure that the G & N System has been operating in the STANDBY MODE (power configuration as defined in 6.2.3.1) for a minimum period of 2 hours. Exceptions to this requirement are noted in 6.2.5.2.9.

CAUTION NOTE: If the requirements of 6.2.3.1.6 are not met, remove IMU operate power immediately by placing the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

6.2.3.1.5 Perform the following sequence:

- Turn on the IMU MNA and MN B circuit breakers on the Hand Circuit Breaker Panel (breakers pushed in).
- Start Analog Recorders.
- Place G/N Power - IMU switch on the LEB Lighting Control Panel to IMU (switch toggle up).

6.2.3.1.6 Immediately begin monitoring the following measurements.

- The IMU Operate Power is $\pm 28.8 \pm 3$ vdc (CG 1500). Verify on CRT.
- On the recorders, verify that oscillations are not sustained and that a null is achieved within 10 seconds of power application in 6.2.3.1.5 on the following measurements:

CG 2112, IG IX Resolver Output Sin
CG 2142, MG IX Resolver Output Sin
CG 2172, OG IX Resolver Output Sin

- Deleted.
- On the CRT, verify the absence of the +120 VDC PIPA supply (CG 1040) for a period of 90±10 seconds following power application in 6.2.3.1.5. After approximately 100 seconds, the voltage shall read $\pm 120 \pm 6$ VDC.
- On the CRT, verify the absence of the +120 VDC PIPA supply (CG 1040) for a period of 90±10 seconds following power application in 6.2.3.1.5. After approximately 100 seconds, the voltage shall read $\pm 120 \pm 6$ VDC.

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- 6.2.3.1.7 Insure that the following alarm lamps are not lighted on G&N LEB Display Panel.
- a. CMC Warning
 - b. ISS Warning
 - c. PGNS Caution
- 6.2.3.1.8 Verify that the PROGRAM ALARM lamp on the DSKY's does not light with VERB 05 NOUN 31 and R1 = 00213 displayed.
- 6.2.3.1.9 The OG, IG, and MG CDU angles shall be 00000±00150. Verify on CRT.
- 6.2.3.1.10 Enter the following into K-148:
- a. VERB 41 NOUN 20, ENTER
 - b. +00000, ENTER
 - c. +00000, ENTER
 - d. +00000, ENTER
- 6.2.3.1.11 Verify that the following secondary power supply voltages are not flashing on the CRT display.

Table VI. Secondary Power Supply Voltages

Meas. No.	Signal
1 CG 1040	+120 VDC PIPA SUPPLY
2 CG 1051	+20 VDC PIPA SUPPLY
3 CG 1052	-20 VDC PIPA SUPPLY
4 CG 1070	+4 VDC CDU SUPPLY
5 CG 1100	-28 VDC ELECTRONICS
6 CG 1020	+14 VDC CMC SUPPLY
7 CG 1030	+4 VDC CMC SUPPLY
8 CG 1201	IMU 28V 800 CPS 1 pot 0 ph
9 CG 1202	IMU 28V 800 CPS 5 pot ph A
10 CG 1203	IMU 28V 800 CPS 5 pot ph B
11 CG 1331	3.2KC 28V SUPPLY
12 CG 1110	2.5 VDC TM BIAS

- 6.2.3.1.12 Monitor the PIPA temperature during the first 15 minutes after switching from Standby Mode to the Operate Mode. The PIPA temperature shall be 130.5±2.0 deg F. during this period. 15 minutes after switching from Standby Mode to the Operate Mode, record the PIPA temperature. The recorded PIPA temperature shall be within 0.5 deg. F. of the Operate stabilized PIPA temperature determined below. Operate power monitor and record Deleted MP (CG 2300) every 5 minutes for 1 hour. Verify that each reading. Deleted MP (CG 2300) every 5 minutes for 1 hour. Verify that each reading. Deleted MP (CG 2300) every 5 minutes for 1 hour. Verify that each reading.
- 6.2.3.1.13 Deleted MP (CG 2300) every 5 minutes for 1 hour. Verify that each reading.
- 6.2.3.1.14 Deleted MP (CG 2300) every 5 minutes for 1 hour. Verify that each reading.
- 6.2.3.1.15 Deleted MP (CG 2300) every 5 minutes for 1 hour. Verify that each reading.
- 6.2.3.1.16 Deleted MP (CG 2300) every 5 minutes for 1 hour. Verify that each reading.

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6.2.4.17 Verify and record the following signals displayed on the CRT:

- a. +120 VDC PIPA SUP. NOISE RMS shall be less than 1.5 VRMS (CG 1042)
- b. +20 VDC PIPA SUP NOISE RMS shall be less than 1.0 VRMS (CG 1053)
- c. +4 VDC CDU SUP NOISE RMS shall be less than 0.10 VRMS (CG 1071)
- d. +28V IMU OPERATE BUS NOISE RMS shall be less than 1.0 VRMS (CG 1501)
- e. +28V IMU STANDBY BUS NOISE RMS shall be less than 1.0 VRMS (CG 1511)
- f. +28V CMC OPERATE BUS NOISE RMS shall be less than 2.0 VRMS (CG 1531).
- g. +28V OPTX OPERATE BUS NOISE RMS shall be less than 2.0 VRMS (CG 1531).

6.2.4.18 The noise peaks of the following signals are demonstrated on the event lights when the peaks have a rise time between 2 and 50 μ sec and the peak voltage exceeds 5 volts.

- a. +14V CMC SUPPLY NOISE PEAKS (CG 1022)
- b. +4V CMC SUPPLY NOISE PEAKS (CG 1032)
- c. +120 VDC PIPA SUPPLY NOISE PEAKS (CG 1045)
- d. +4 VDC CDU SUPPLY NOISE PEAKS (CG 1072)
- e. +28V IMU OPERATE BUS NOISE PEAKS (CG 1502)
- f. +28V IMU STANDBY BUS NOISE PEAKS (CG 1512)
- g. +28V CMC OPERATE NOISE PEAKS (CG 1522)
- h. +28V OPTX OPERATE NOISE PEAKS (CG 1532)

6.2.4.19 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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6.2.5 General Turn Off and Turn On Procedure

NOTE: This procedure shall be utilized any time after performing 6.1.3 Prepower Application Requirements, 6.2.1, Standby Power On Test, and 6.2.3. Operate Power on Test, to turn on or turn off the G&N System. Appropriate portions of this procedure will be referenced in other tests.

6.2.5.1 Turn Off Procedure

CAUTION: This procedure must be performed in the sequence specified. Failure to adhere to this sequence may require calibration of the inertial components.

6.2.5.1.1 Enter the following sequence into the K-148.

- a. VERB 41 NOUN 20, ENTER
- b. +00000 ENTR
- c. +00000 ENTR
- d. +09000 ENTR

On the G&N Indicator Control Panel verify PGNS light is ON. On the DSKY verify NO ATT light is ON. Verify that the GIMBAL LOCK indicator on the DSKY is illuminated.

6.2.5.1.2 Set the following switches on the G&N Indicator Control Panel to the positions designated.

- a. OPTICS ZERO to ZERO
- b. OPTICS MODE to MAN
- c. OPTICS COUPLING to DIRECT
- d. OPTICS SPEED to MED
- e. OPTICS TEL TRUN to SLAVE to SXT
- f. RETICLE BRIGHTNESS to minimum brightness position

6.2.5.1.3 Set the G/N Power - IMU switch on the LEB Lighting Control Panel to OFF and G&N IMU MN A and MN B circuit breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).

6.2.5.1.3.1 On K-148 enter the following:

VERB 21 NOUN 01 ENTR
00034 ENTR
00000 ENTR
Gimbal Lock and PGNS. CAUTION lamp shall extinguish.
VERB 36 ENTR
The NO ATT lamp shall extinguish
The NO ATT lamp shall extinguish.

6.2.5.1.4 Decrease the LIGHTS - NUMERICS controls on both the Left Hand Circuit Breaker panel and the LEB Lighting Control Panel to the minimum brightness - OFF position.

6.2.5.1.5 Set the PSAAM power switch on the PSAAM of OFF.

6.2.5.1.6 Set the IMU HTR MN A and MN B circuit breaker on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).

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- 6.2.5.1.7 Set the G&N Power AC1-OFF-AC2 Switch on the Right Hand Circuit breaker panel to OFF and the G&N POWER AC1 and AC2 circuit breakers to OFF (breakers pulled out).
- 6.2.5.1.8 Set the G/N POWER - OPTICS switch on the LEB Lighting Control Panel to OFF and G&N OPTICS MN A and MN B breakers on the Right Hand circuit breaker panel to OFF.
- 6.2.5.1.9 Set the COMPUTER MN A and MN B Circuit breakers on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).
- 6.2.5.1.10 Verify that the ICTC is supplying inertial components heater power to the G&N System. This will be indicated by the following on the PTC.
- G&N ON (PTC inhibit) light not illuminated.
 - IMU Temp/heater current meter indicates IMU temperature of 130° ±5°F.
- 6.2.5.2 Turn ON Procedure
- 6.2.5.2.1 Set or verify the following G&N Indicator Control Panel switches to the position indicated.
- CONDITION LAMPS to ON
 - OPTICS ZERO to ZERO/AL
 - OPTICS MODE to MANING to DIRECT
 - OPTICS COUPLING to DIRECT ST
 - OPTICS SPEED to DC ON to SLAVE to EXT
 - OPTICS TEL/TRUN to SLAVE to EXT brightness position.
 - RETICLE BRIGHTNESS to minimum brightness position.
- 6.2.5.2.2 Insure that interfacing system EPS and ECS are turned on and operating properly.

CAUTION: The remaining procedure must be followed in sequence specified. Failure to adhere to this sequence may require recalibration of the inertial components.

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- 6.2.5.2.3 Energize the G&N COMPUTER MNA and MNB breakers on the Right Hand Circuit Breaker panel (Breakers pushed in). Enter VERB 61 into K148 and press the ENTER pushbutton. Verify +14 and +4 VDC CMC power supply outputs on CRT display. Voltages shall be +14.0±0.4 VDC (CG 1020) and +4.0±0.2 VDC (CG1030). NOTE: Restart Lamp may illuminate; if it does, disregard and press RSET on the DSKY.
- On DSKY verify TEMP light is ON. On the G&N Indicator Control Panel verify PGNS light is ON.
- 6.2.5.2.4 Set the G&N POWER AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in). Set the G&N POWER AC1-OFF-AC2 switch to AC1
- 6.2.5.2.4.1 Set the G&N DSKY and Display Panel brightness to the minimum acceptable level by manipulation of LIGHTS - NUMERICS control on both Left Hand circuit breaker panel and LEB Light Control Panel.
- 6.2.5.2.5 Energize the G&N IMU HTR MNA and MNB breakers on the Right Hand Circuit Breaker panel (breakers pushed in). Insure that the CMC +28 VDC discrete lamp on the Event Module is illuminated (CG 1523). Verify TEMP light on DSKY is extinguished. Verify PGNS light on the G&N Indicator Control Panel is extinguished.
- 6.2.5.2.5.1 Set/Verify the following switches on the PSAAM.
- PSAAM POWER to ON
 - INHIBIT VOLTAGE FAIL to OFF.
- 6.2.5.2.6 Enter VERB 36 into K148. Press ENTER pushbutton. Press ERROR RESET pushbutton on K-Start. All computer alarms except the Gimbal Lock Indicator on the Main Display Console (MDC) and LEB AGC DSKY shall clear. Verify registers R1, R2, and R3 on the DSKY's are cleared. Verify PROG = 00..
- 6.2.5.2.7 Deleted.
- 6.2.5.2.8 Initiate CMC Self-Test by entering the following into the K-Start:
- VERB 21, NOUN 27, ENTER
 - 77777, ENTER
 - VERB 15, NOUN 01, ENTER
 - 01366, ENTER
- 6.2.5.2.8.1 Monitor DSKY until R3 (SCOUNT+2) increments twice. If an error is detected, the following will be displayed:
- VERB 05, NOUN 31
 - R1 = 01102
 - R2 = XXXXX c (SFAIL)
 - R3 = XXXXX c (ERCOUNT)
- 6.2.5.2.8.2 Terminate the monitor routine by entering the following into the DSKY
- VERB 34, ENTER
- 6.2.5.2.8.3 Terminate Self-Test by entering the following into the K-Start:
- VERB 21, NOUN 27, ENTER
 - 00000, ENTER

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6.2.5.2.8.4 Enter the following in K-148 to turn on the Computer Activity Light.

- a. VERB 34 ENTR
- b. VERB 21 NOUN 27 ENTR
- c. 00000 ENTR
- d. VERB 25 NOUN 01 ENTR
- e. 03770 ENTR SET LOC
- f. 10067 ENTR CCS NEW JOB
- g. 05532 ENTR TC CHANG1
- h. 01770 ENTR TC ACTLITON
- i. VERB 25 NOUN 26 ENTR CALL PRIO/DELAY
- j. 01000 ENTR 01 PRIORITY
- k. 01770 ENTR RELATIVE E-MEM
- m. 00007 ENTR BANKADD
- n. VERB 30 ENTR REQ EXEC

NOTE: If a VERB 36 is performed after the above information has been entered repeat lines 6.2.5.2.8.4.i through 6.2.5.2.8.4.n

NOTE: Allow 2 hours to elapse before proceeding to 6.2.5.2.9 with the following exceptions:

- a. If the G&N System has been in the power off state for less than 5 days with the gimbals in the parked position (0°, 0°, 90°) and the system has not been moved, allow 15 minutes to elapse before proceeding.
- b. If the G&N System has been turned off with the gimbals in the unparked position for less than 2 hours allow a warmup time equal to the time off but not less than 15 minutes to elapse before proceeding.

CAUTION: If the requirements of 6.2.5.2.10 are not met, remove IMU Operate Power immediately by setting the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

6.2.5.2.9

After the required warmup time has elapsed set the G&N IMU MN A and MN B circuit breaker on the Right Hand circuit breaker panel to ON (breaker pushed in), and the G/N POWER - IMU switch on the LEB Lighting Control panel to the ON position (toggle up).

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6.2.5.3.5 Enter the following into K148:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

Observe the NO ATT lamp lights and the Inner, Outer, and Middle Gimbal angles are 0±1.5° as indicated by the CDUX, CDUY, and CDUZ displays on the CRT.

6.2.5.3.6 Insure that the following switches are set to the positions indicated.

- a. OPTICS COUPLING ~~to DIRECT~~ DIRECT
- b. OPTICS ZERO ~~to ZERO~~
- c. OPTICS MODE ~~to MAN~~ MAN to SLAVE TO SXT
- d. OPTICS TEL TRUN ~~to SLAVE~~ to SXT
- e. OPTICS SPEED ~~to LO~~ to LO
- f. CONDITION LAMPS ~~to ON~~
- g. UP TELEMETRY ~~to ACCEPT~~

6.2.5.3.7 Deleted. ENTER RESET procedure.

- a. VERB 57, ENTER
- b. 00015, ENTER

6.2.6 G&N Operational Test

6.2.6.1 Initial Conditions

Proceed with this test if the Operate Power On Test of 6.2.3 or the Turn on Procedure of 6.2.5 has been completed and system operation has not be interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding.

6.2.6.1.1 Enter the following into K-148:

- a. VERB 01 NOUN 10, ENTER
 - b. 00003, ENTER
- Record R1 = AAAAA and the time of day

6.2.6.1.2 Enter the following into K-148.

- a. VERB 21 NOUN 02, ENTER
 - b. 01300, ENTER
 - c. AAAAA, ENTER (from 6.2.6.1.1)
 - d. VERB 06 NOUN 02, ENTER
 - e. 01300, ENTER
- Record R1 = BBBBB

6.2.6.1.3 Perform the following calculations:

- a. $\frac{R1 (BBBBB) \times 5.12}{3600} = CC.C$ (hours in high order scaler Channel 03)

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6.2.7.4 Middle Gimbal Friction Test

6.2.7.4.1 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

- a. CG 2150 MG TORQUE MOTOR CURRENT
- b. CG 2147 MGA SERVO ERROR IN PHASE
- c. CG 2142 MG 1X RESOLVER OUTPUT SIN
- d. CG 2143 MG 1X RESOLVER OUTPUT COS
- e. CG 2250 MGA CDU FINE ERROR
- f. CG 2251 MGA CDU Coarse Error
- g. CG 2148 MG 1X RESOLVER OUTPUT TAN
- h. CG 2149 MG 1X RESOLVER OUTPUT SEC

6.2.7.4.2 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (+135° MG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00411, ENTER
- c. 63777, ENTER
- d. 77777, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (j) appears in R3.

6.2.7.4.3 Enter the following sequence in the K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.4.4 Start the analog recorder.

6.2.7.4.5 Verify that MG Servo Error Quadrature (CG 2138) is 0.0 ± 1.2 VRMS. Observe measurement CG 2142, MG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs (approximately 5 minutes), stop the recorders.

6.2.7.4.6 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 40 NOUN 01, ENTER
- b. VERB 41 NOUN 20, press ENTER
- c. +00000, press ENTER
- d. +00000, press ENTER
- e. +06750, press ENTER

6.2.7.4.7 Enter the following sequence into the K-Start. Push ENTER pushbutton after each entry (-135° MG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00411, ENTER
- c. 14000, ENTER
- d. 00000, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

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- 6.2.7.4.8 Enter the following sequence in the K-Start:
- a. VERB 42, press ENTR
 - b. VERB 33, press ENTR (Verify VERB 33 on CRT)
- 6.2.7.4.9 Start analog recorders.
- 6.2.7.4.10 Observe measurement CG 2142, MG 1X Resolver output SIN, on the analog recorder. When the steady-state condition occurs (approximately 5 minutes), stop the recorders.
- 6.2.7.4.11 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.
- a. VERB 36, ENTER
 - b. VERB 40 NOUN 20, press ENTER
 - c. VERB 41, NOUN 20, press ENTER
 - d. +00000, press ENTER
 - e. +00000, press ENTER
 - f. +00000, press ENTER
- 6.2.7.5 Examine the traces of the recorded measurements for all six phases of this test to detect any sharp discontinuities. Disregard transients of 0.5 second duration or less on the Gimbal Torque motor current traces. The Gimbal Torque motor currents shall not exceed 0.125 ampere. The CDU Fine Error measurements shall not exceed ± 70 mvrms. The CDU Coarse Error measurement shall not exceed ± 680 mv rms.

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- 6.2.9.22 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 20 seconds VERB 06 NOUN 55 shall flash on the CRT. The ISS WARNING lamp on the Control Indicator Panel shall extinguish. The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be OFF.
- 6.2.9.23 Set the OPTICS ZERO switch on the Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Set the OPTICS MODE switch to CMC.
- 6.2.9.24 Enter VERB 33 into K-148 and press the ENTER pushbutton. After approximately 25 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 66 flashing
 - b. R1 = 000xx
 - c. R2 = xxxxx
- Record R1 and R2 as the Shaft Optics CDU drive rate.
Shaft rate = $\frac{R1}{R2}$. The Shaft Optics CDU drive rate shall be $7.32 \pm 1.83^\circ/\text{sec}$.
- 6.2.9.25 Enter VERB 33 into K148. Press the ENTER pushbutton. In about 15 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 66
 - b. R1 = 0000x
 - c. R2 = xxxxx
- Record R1 and R2 as the Trunnion Optics CDU drive rate. Trunnion rate = $\frac{R1}{R2}$. The Trunnion Optics CDU drive rate shall be $1.83 \pm 0.45^\circ/\text{sec}$.
- 6.2.9.26 Terminate the Semi-Automatic Moding Check by entering VERB 34 into K148. Observe PROG display on DSKY's is 00. Press the ENTER pushbutton. Set the G&N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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6.2.10 Zero Optics Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 Turn On procedure before proceeding.

INITIALIZATION

6.2.10.1 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.10.2 Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.

- a. VERB 41 NOUN 20 ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.10.3 Insure that the following switches on the G&N Indicator Control Panel are set as follows:

- a. OPTICS TEL TRUN to SLAVE TO SXT
- b. OPTICS COUPLING to DIRECT
- c. OPTICS SPEED to HI
- d. OPTICS MODE to MAN

OPTICS ZERO MODE TEST

6.2.10.4 Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K-148. Press the ENTER pushbutton.

6.2.10.5 Set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following on R1 and R2 of the DSKY.

- a. R1 = +0.00° +0.02°, -0.03° (Shaft Angle)
- b. R2 = +0.000° +0.006°, -0.007° (Trunnion Los Angle)

6.2.10.5.1 Enter the following:

VERB 01 NOUN 10, ENTER
00033, ENTER
Verify R1 = XXX6X

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- 6.2.10.5.2 Return the OPTICS ZERO switch to OFF. Set the OPTICS MODE switch to CMC. Enter the following:

ENTER
07033, ENTER
Verify R1 = XXX5X

- 6.2.10.5.3 Set the OPTICS MODE switch to MAN. Press the KEY REL pushbutton on the DSKY.

OPTICS TIME TO ZERO TEST

- 6.2.10.6 Set up the Analog Recorder to monitor the following measurements. Use a chart speed of 10 mm/sec.

- CG 3140 SXT Shaft Tach Output
- CG 3150 SXT Trunnion Tach Output
- CG 3160 SCT Shaft Tach Output
- CG 3170 SCT Trunnion Tach Output
- CG 3117 SXT Shaft Servo Error in Phase
- CG 3118 SXT Trunnion Servo Error in Phase

- 6.2.10.7 Push the Optics Hand Controller to the right, driving the SXT Shaft until R1 on the DSKY indicates $+180 \pm 1^\circ$. Push the Optics Hand Controller up, driving the SXT Trunnion until R2 on the DSKY indicates $+75 \pm 1^\circ$.

- 6.2.10.8 Start the Analog Recorders and set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO.

- 6.2.10.9 Monitor the Analog Recorders until all signals return to null. Stop the Analog Recorders. The elapsed time between the initial and final SXT Shaft and Trunnion Tach output nulls shall be less than 15 seconds. The peak magnitude of the SXT Shaft (CG 3140) and Trunnion (CG 3150) tach outputs shall be -3.3 ± 1.3 VRMS. The peak magnitude of the SCT Shaft Tach Output (CG 3160) shall be 3.3 ± 1.3 VRMS. The peak magnitude of the SCT Trunnion Tach Output (CG 3170) shall be 0.85 ± 0.35 VRMS. The SXT Shaft (CG 3117) and Trunnion (CG 3118) Servo Error in Phase measurements shall each have a maximum magnitude of 2 VRMS.

- 6.2.10.10 Record R1 and R2 on the CRT. The data displayed shall be as follows:

- $R1 = +0.00^\circ \pm 0.02^\circ, -0.03^\circ$ (Shaft Angle)
- $R2 = +0.000^\circ \pm 0.006^\circ, -0.007^\circ$ (Trunnion Los Angle)

Enter VERB 34 and press the ENTER pushbutton.

- 6.2.10.11 Record the Telescope Panel Angle Counter indications. The Shaft Angle shall be 0.0 ± 0.11 degrees. The Trunnion Angle shall be 0.0 ± 0.22 degrees.

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- 6.2.10.12 Set the OPTICS ZERO switch on the G&N Indicator Control Panel to OFF. Set the G&N Power Optics Switch on the LEB Lighting Control Panel to OFF.

OPTICS BACKUP MODE TEST

- 6.2.10.13 Insert the inflight tool (V36601405) into the Trunnion Tool input and engage drive mechanism (button out). Verify that the trunnion turns by viewing the movement through the SCT eyepiece while turning the tool until the TPAC reads +5 deg. Remove the tool from the trunnion tool input.
- 6.2.10.14 Insert the inflight tool (V36601405) into the Shaft Tool input and engage the drive mechanism (button out). Verify that the Shaft turns by viewing the movement through the SCT eyepiece while turning the tool so that the shaft moves through an angle from 0° to +3° to 0 as indicated on the shaft TPAC. Disengage the shaft drive mechanism (button in) and remove the tool.
- 6.2.10.15 Insert the inflight tool (V36601405) into the Trunnion Tool input. Verify that the Trunnion turns by viewing the movement through the SCT eyepiece while turning the tool so that the trunnion moves from +5° to -5° and back to zero as indicated on the Trunnion TPAC. Disengage the trunnion drive mechanism (button in) and remove the tool.

6.2.11 OPTICS Coordinate Transformation Control Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding.

INITIALIZATION

- 6.2.11.1 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±0.3 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.
- 6.2.11.2 Enter the following into the K-Start. Press the ENTER pushbutton after each entry.
- a. VERB 41 NOUN 20, ENTER
 - b. +00000, ENTER
 - c. +00000, ENTER
 - d. +00000, ENTER
- 6.2.11.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the position indicated.
- a. OPTICS TEL TRUN to SLAVE to SXT
 - b. OPTICS COUPLING to DIRECT

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- c. OPTICS SPEED to HI
- d. OPTICS MODE to MAN

6.2.11.4 Set up the analog recorders to monitor the following measurements:

- a. CG 3170 SCT Trunnion Tachometer Output

6.2.11.5 Enter the following into the K-Start to monitor the OPTICS CDU's.

VERB 16 NOUN 55, press ENTER

6.2.11.6 Set the OPTICS ZERO switch on the G&N Panel to ZERO. Wait 15 seconds. Return the OPTICS ZERO switch to OFF.

RESOLVED MODE PHASING AND IMAGE RATE TEST

6.2.11.7 Using the OPTICS CONTROL STICK, drive the Optics until R1 = +225.00 and R2 = +10.000 on the CRT and the DSKY's.

6.2.11.8 Set the OPTICS COUPLING switch on the G&N Panel to RSLV and controller speed switch to MED.

6.2.11.9 Position the movable optics target such that it is centered on the SCT retical pattern, then start the analog recorders.

6.2.11.10 Quickly displace the OPTICS CONTROL STICK 45 ± 10 degrees in the upper right hand quadrant while sighting on the optics target through the SCT eyepiece. The target shall appear to move in the upper right field of view of the SCT at 45 ± 10 deg. When target leaves the SCT upper right field of view press MARK pushbutton and immediately record the shaft angle as displayed on R1 of the DSKY. The recorded shaft angle shall be $+225 \pm 10.00$ degrees.

6.2.11.11 Stop the analog recorder and measure the elapsed time between the initial and the final signal null conditions for the trunnion measurement. The elapsed time shall be +19 to +32 seconds.

CSC AMPLIFIER SHAFT AND TRUNNION DRIVE TEST

6.2.11.12 Set the OPTICS COUPLING switch to DIRECT. Again using the OPTICS CONTROL STICK, drive the optics until R1 = +225.00 and R2 = +10.000. Set the OPTICS COUPLING switch to RSLV.

6.2.11.13 While sighting on the optical target through the SCT eyepiece displace the OPTICS CONTROL STICK fully to the right. Verify that the target image appears to move in a straight line horizontally to the right and release the OPTICS CONTROL STICK when the target image reaches the edge of the SCT field of view.

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- 6.2.11.14 Enter VERB 34 in the DSKY.
Press the ENTER pushbutton.
- 6.2.11.15 Set the OPTICS COUPLING switch on the G&N Panel to DIRECT. Set the OPTICS ZERO switch to ZERO.
- NOTE: If Optics testing will continue, set the G/N POWER OPTICS switch on the LEB Lighting Control Panel to OFF.
- 6.2.12 Optics Functional Test
- Proceed with this test if 6.2.3 Operate Power On Test, or 6.2.5.2, Turn-On Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2, Turn On Procedure, before proceeding.
- NOTE: This test requires the use of the G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT StLOS before proceeding. Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.
- 6.2.12.1 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Set Tracker switch to OFF. Verify the following:
- +28 VDC OPTX OPERATE BUS (CG 1530) is 28.8±3 VDC. Record the indication on the CRT.
 - CG 1211 OPTX 28V 800 cps 1% 0 ph not flashing on CRT.
 - CG 1212 OPTX 800 cps 5% - 90 ph not flashing on CRT.
- 6.2.12.2 Enter the following sequence into the K-Start.
- VERB 41, NOUN 20, ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER
- 6.2.12.3 Insure that Optics Control switches on the G&N Indicator Control Panel are set as follows:
- OPTICS ZERO to OFF
 - OPTICS MODE to MAN
 - OPTICS SPEED to LO
 - OPTICS COUPLING to DIRECT
 - OPTICS TEL TRUN to SLAVE to SXT

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- 6.2.12.4 Set the OPTICS ZERO switch to ZERO. After 15 seconds return the switch to OFF.
- 6.2.12.5 Resolution Checks
- 6.2.12.5.1 Sight through the SXT eyepiece. Using the OPTICS CONTROL STICK, adjust the SXT to obtain the best reflected field of view of the 5-inch autocollimator reticle engravings at the center of the field of view.
- 6.2.12.5.2 Note that the autocollimator reticle contains a series of lines of different thickness and width. Each set of lines is marked with a number (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines. The SXT resolution shall be at least 10 arc-seconds at the center of the field of view.
- 6.2.12.5.3 Repeat 6.2.12.5.1 and 6.2.12.5.2 using the SCT and the SCT resolution chart. The SCT shall have a resolution of at least 3 arc-minutes at the center of the field of view.
- 6.2.12.6 Slave Telescope Mode Checks
- 6.2.12.6.1 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.6.2 Set the OPTICS ZERO switch on the Control Indicator Panel to ZERO. Wait 15 seconds.
- 6.2.12.6.3 Record the SCT Shaft and Trunnion angles as indicated by the TPAC and the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between the TPAC Shaft angle and the Shaft CDU angle shall be ± 0.11 degree or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be ± 0.22 degree or less.
- 6.2.12.6.4 Place the OPTICS ZERO switch to OFF. Using the OPTICS CONTROL STICK drive the SXT Shaft and Trunnion CDU's until $R1 = +035.00 \pm 0.10$ degree and $R2 = 35.000 \pm 0.100$ degree, setting the CONTROLLER SPEED switch to LO as the angles are approached. Press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles as indicated by the TPAC. Record R1 and R2. The difference between the TPAC Shaft angle and the Shaft CDU angle shall be ± 0.11 deg or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be ± 0.22 deg or less.
- 6.2.12.6.5 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton. Set the OPTICS ZERO switch to ZERO.
- 6.2.12.6.6 Set the OPTICS TEL TRUN switch to SLAVE to SXT position.

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- 6.2.12.6.7 Remove the plug from the base of the SXT eyepiece and install the Adapter Assembly and Portable Light Assembly. Turn on the light.
- NOTE: If needed to reduce external light, place a photographer's hood over the optics head and retroreflecting prism.
- 6.2.12.6.8 Sight through the SCT eyepiece and provide direction to personnel outside spacecraft for positioning the Retroreflecting Prism, Model No. A23-200, to span between the SXT LLOS and SCT LOS such that the illumination from the back-light filament is clearly visible at the center of the field of view. Prism must be held in this alignment position until completion of Step 6.2.12.6.11.
- 6.2.12.6.9 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Note the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement, expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. For instance, the outer ends of the SXT reticle lines are 6% from center. Displacement shall be less than 50% (bar must be closer to center than to edge of field of view).
- 6.2.12.6.10 Set the OPTICS TEL TRUN switch to 0° position.
- 6.2.12.6.11 Again direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in Step 6.2.12.6.9. Place the OPTICS MODE switch to MAN and observe the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. Displacement shall be less than 50%.
- 6.2.12.6.12 Remove the Retroreflecting Prism.
- 6.2.12.6.13 Replace the Portable Light in the adapter on the SXT eyepiece.
- 6.2.12.6.14 While sighting into the SCT eyepiece, set the OPTICS TEL TRUN switch to 25 deg. and observe that the resolution pattern mounted outside the spacecraft appears to move downward from the center of the field of view to the zero reticle marking that is 25 deg. below the center of the field of view.
- 6.2.12.6.15 Record the TPAC Trunnion Angle. It shall be 25.00° ± .22°.
- 6.2.12.6.16 Set the OPTICS TEL TRUN switch to SLAVE TO SXT. Set the OPTICS ZERO switch to OFF.

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- 6.2.12.7 SXT Parallelism Tests
- 6.2.12.7.1 Using the OPTICS CONTROL STICK drive the SXT StLOS Trunnion to $+15.000 \pm 2$ degree as indicated in R2 of the DSKY. Maintain a Shaft CDU angle of 000.00 ± 0.10 degree as indicated by R1 on the DSKY.
- 6.2.12.7.2 Sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to superimpose the SXT LLOS horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.
- 6.2.12.7.3 Repeat 6.2.12.7.2 twice. Calculate and record the average of the three autocollimator readings.
- 6.2.12.7.4 Set the OPTICS ZERO switch to ZERO.
- 6.2.12.7.5 Again sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to bring the SXT StLOS horizontal reticle and autocollimator horizontal filar images to coincide. Record the autocollimator reading.
- 6.2.12.7.6 Repeat 6.2.12.7.5 twice. Calculate and record the average of the three autocollimator readings. The average value obtained here shall not differ from that obtained in 6.2.12.7.3 by more than 10 arc-seconds.
- 6.2.12.7.7 Set the OPTICS ZERO switch to OFF. Using the OPTICS CONTROL STICK drive the SXT Trunnion angle to 85.000 ± 5 degrees as indicated on R2 of the DSKY. Set the OPTICS SPEED to LO and drive the SXT Trunnion to $+90.000 \pm 0.100$ degrees as indicated on R2 of the DSKY. Insure that the SXT Shaft angle remains at 000.00 ± 0.10 degrees as indicated by R1 on the DSKY.
- 6.2.12.7.8 Sight through the SXT. Two reticle patterns shall be visible. Use the OPTICS CONTROL STICK to adjust the SXT Trunnion angle until the two horizontal reticle lines are coincident. Record the Trunnion CDU angle displayed in R2. The Trunnion CDU angle shall be 90.000 ± 0.010 degrees.
- 6.2.12.7.9 Remove the Portable Light Assembly and Adapter Assembly from the base of the SXT eyepiece. Replace the SXT eyepiece plug.
- NOTE: If Optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.
- 6.2.12.8 Shaft and Trunnion Positional Accuracy Checks
- 6.2.12.8.1 Set the OPTICS ZERO switch to ZERO. After 15 seconds, return the selector to OFF.
- 6.2.12.8.2 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton.

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- 6.2.12.8.3 Sight through the SXT. Using the control stick align the SXT SLOS with optical target No. 1 on the G&N Installation Fixture Model No. A23-097. Set the OPTICS SPEED switch to LO as the target is approached. When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.
- 6.2.12.8.4 Sight through the SXT. Using the control stick align the SXT SLOS with optical target No. 2 on A23-097. Set the OPTICS SPEED switch to LO as the target is approached.
- 6.2.12.8.5 When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.
- 6.2.12.8.6 Set the OPTICS ZERO switch to ZERO. After 15 seconds set the switch to OFF. Set the OPTICS MODE switch to CMC.
- 6.2.12.8.7 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.8 Enter the value recorded from R1 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.9 Enter the value recorded from R2 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.10 Sight through the SXT. The SLOS should be centered on Optical Target No. 1 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.3 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.11 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.12 Enter the value recorded from R1 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.13 Enter the value recorded from R2 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.14 Sight through the SXT. The SLOS should be centered on Optical Target No. 2 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.5 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.15 Set the OPTICS ZERO switch to ZERO. After 15 seconds return the switch to OFF.

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- 6.2.12.8.16 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start 3 times. Press the ENTER pushbutton after each entry.
- 6.2.13 Optics Slew Rate Test
- NOTE: Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.13.1 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.
- 6.2.13.2 Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.
- a. VERB 41 NOUN 20, ENTER
 - b. +00000, ENTER
 - c. +00000, ENTER
 - d. +00000, ENTER
- 6.2.13.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the positions indicated.
- a. TEL TRUN to SLAVE to SXT
 - b. OPTICS COUPLING to DIRECT
 - c. OPTICS SPEED to HI
 - d. OPTICS MODE to MAN
- 6.2.13.4 Monitor MARK COMMAND by entering VERB 06 NOUN 56 into K-148. Press the ENTER pushbutton.
- TRUNNION SLEW RATE - HI SPEED
- 6.2.13.5 Set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds.
- Set the OPTICS ZERO switch on the G&N Indicator Control Panel to OFF.
- NOTE: Read and understand step 6.2.13.6 before proceeding. Do not hold Control Stick at upper limit more than 10 seconds, or exceed a trunnion angle of 85 degrees.
- 6.2.13.6 Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds.

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(before display changes). The data displayed is in the following form:

- a. $R2 = \pm XX.XXX$ (Trunnion LOS angle in deg)
- b. $R3 = +XXX.XX$ (Time in seconds)

After the display has changed, again record the value of R2 and R3.

6.2.13.7

Perform the following calculations:

NOTE: In performing calculation b. below, and in similar calculations throughout this test procedure, the following shall be noted and taken into account. It is possible that the second R3 reading may be smaller than the first reading. If so, add an overflow time value of 163.84 sec to the second reading and then subtract the first reading, in order to obtain Δ time as the difference of the two R3 readings.

- a. Difference between R2 displays = _____ (Δ trun. angle)
- b. Difference between R3 displays = _____ (Δ time)
- c. $\frac{\Delta \text{ trun. angle}}{\Delta \text{ time}} = \text{---}^\circ \text{---} \text{ deg/sec}$

The trunnion slew rate shall be 10 ± 2 deg/sec.

SHAFT SLEW RATE - HI SPEED

6.2.13.8

Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand step 6.2.13.9 before proceeding. Do not hold Control Stick at right limit for more than 10 seconds, or exceed a shaft angle of 250 degrees.

6.2.13.9

Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 sec. (before display changes). The data displayed is in the following form:

- a. $R1 = \pm XXX.XX$ (Shaft angles in deg.)
- b. $R3 = +XXX.XX$ (Time in seconds.)

After the display has changed, again record the values of R1 and R3.

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6.2.13.10

Perform the following calculations:

- a. Difference between R1 displays = _____. (Δ shaft angle)
- b. Difference between R3 displays = _____. (Δ time)
- c. $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{_____ deg/sec}$

The Shaft Slew Rate shall be 19.5±3.9 deg/sec

TRUNNION SLEW RATE - MED SPEED

6.2.13.11

Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Set the OPTICS SPEED switch to MED. Monitor MARK command by entering VERB 06 NOUN 56 in K148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.12 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

6.2.13.12

Record the SXT TRUN MTR control winding (CG 3155) signal on the CRT while slewing the optics. The voltage shall be +0.25 to +2.00 VRMS. Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R2 = +XX.XXX (Trunnion LOS angle in deg)
- b. R3 = +XXX.XX (Time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.13

Perform the following calculations:

- a. Difference between R2 displays = _____. (Δ trunnion angle)
- b. Difference between R3 displays = _____. (Δ time)
- c. $\frac{\Delta \text{trunnion angle}}{\Delta \text{time}} = \text{_____ deg/sec}$

The Trunnion Slew Rate shall be 1.0±0.2 deg/sec.

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SHAFT SLEW RATE - MED SPEED

- 6.2.13.14 Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to MAN. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.15 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

- 6.2.13.15 Record the SXT SHAFT MTR control winding (CG 3145) signal on the CRT while slewing the optics. The voltage shall be +0.50 to +4.00 VRMS. Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R1 = +XXX.XX (Shaft angles in deg)
- b. R3 = +XXX.XX (Time in seconds)

After the display has changed, again record the values of R1 and R3.

- 6.2.13.16 Perform the following calculations:

- a. Difference between R1 displays = ---.--- (Δ shaft angle)
- b. Difference between R3 displays = ---.--- (Δ time)
- c. $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{---.--- deg/sec}$

The Shaft Slew Rate shall be $2.0 \pm 0.4 \text{ deg/sec}$.

TRUNNION SLEW RATE - LO SPEED

- 6.2.13.17 Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Set the OPTICS SPEED switch to LO. Monitor MARK command by entering the VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.18 before proceeding. Do not hold control stick at upper limit for more than 30 seconds.

- 6.2.13.18 Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 sec (before display changes). The data displayed is in the following form:

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- a. R2 = $\pm XX.XXX$ (Trunnion LOS angle in deg)
- b. R3 = $+XXX.XX$ (Time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.19 Perform the following calculations:

- a. Difference between R2 displays = $---.---$ (Δ trunnion angle)
- b. Difference between R3 displays = $---.---$ (Δ time)
- c. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}} = --- \text{ deg/sec.}$

The Trunnion Slew Rate shall be $0.10 \pm 0.02 \text{ deg/sec.}$

SHAFT SLEW RATE - LO SPEED

6.2.13.20 Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Monitor MARK command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.21 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.21 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 sec (before display changes). The data displayed is in the following form:

- a. R1 = $\pm XXX.XX$ (Shaft angle in deg)
- b. R3 = $+XXX.XX$ (Time in seconds)

After the display has changed, again record the values of R1 and R3.

6.2.13.22 Perform the following calculations:

- a. Difference between R1 displays = $---.---$ (Δ shaft angle)
- b. Difference between R3 displays = $---.---$ (Δ time)
- c. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = --- \text{ deg/sec}$

The Shaft Slew Rate shall be $0.20 \pm 0.04 \text{ deg/sec.}$

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OPTICS HAND CONTROLLER DRIFT RATE CHECK - LO SPEED

6.2.13.23 Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF.

6.2.13.24 Press the MARK pushbutton and record the display in R1, R2 and R3. Approximately 60 seconds after the first MARK, again press the MARK pushbutton and record the new data displayed in R1, R2, and R3. The data displayed is in the following form:

- a. R1 = ±XXX.XX (Shaft angle in deg)
- b. R2 = ±XX.XXX (Trunnion LOS angle in deg)
- c. R3 = +XXX.XX (Time in seconds)

6.2.13.25 Perform the following calculations:

- a. Difference between R1 displays = _____ (Δ shaft angle)
- b. Difference between R2 displays = _____ (Δ trunnion angles)
- c. Difference between R3 displays = _____ (Δ time)
- d. $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{_____ deg/sec (shaft drift rate)}$
shall be less than 0.0333 deg/sec.
- e. $\frac{\Delta \text{trunnion angle}}{\Delta \text{time}} = \text{_____ deg/sec (trunnion drift rate)}$
shall be less than 0.0167 deg/sec.

6.2.13.26 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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- 6.2.14 Stabilization Loop Step Response Test
- 6.2.14.1 Proceed with this test if the Operate Power On Test of 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding.
- 6.2.14.2 Insure that the Carry-on Command Stimuli Unit, Model No. C14-200, is installed and connected.
- 6.2.14.3 Enter VERB 36 into K148. Press the ENTER pushbutton, then the ERROR RESET pushbutton.
- 6.2.14.4 Inner Gimbal Response Test
- 6.2.14.4.1 Enter code 2032000000 in C-START Module 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2117 IGA SERVO ERROR on 4A1-A3-CH1.
- 6.2.14.4.2 Enter VERB 41 NOUN 20 into K148. Press ENTER pushbutton.
- 6.2.14.4.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.
- 6.2.14.4.4 Enter VERB 42 into K148. Press ENTER.
- 6.2.14.4.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.
- 6.2.14.4.6 Enter 0001 into R154. Verify and execute to apply +28 VDC ACE ENABLE to the PSAAM.
- 6.2.14.4.7 Enter 1000 into R155. Verify and execute to enter a DC step into the IG stabilization loop.
- CAUTION: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.
- 6.2.14.4.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.
- 6.2.14.4.9 Enter 0000 into 4A3-A6-R155; the top part of switch should be extinguished. Insure that no other function switches on 4A3-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the IG Stabilization Loop. The bottom part of switch shall be extinguished.
- 6.2.14.4.10 After the transient has died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step input and the settling of the error signal to a value equal to ± 5 percent of the original step amplitude. In addition, record the total number of overshoots.

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6.2.14.4.10.1 The inner gimbal stabilization loop response time shall be less than 0.1 second.

6.2.14.4.10.2 The maximum number of overshoots on the IGA Servo Error signals shall be three.

6.2.14.5 Middle Gimbal Response Test

6.2.14.5.1 Enter code 2028000000 into C-START MODULE 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2147 MGA SERVO ERROR on 4A1-A3-CH1.

6.2.14.5.2 Enter VERB 41 NOUN 20 into K148. Press ENTER.

6.2.14.5.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.

6.2.14.5.4 Enter VERB 42 into K148. Press ENTER.

6.2.14.5.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.

6.2.14.5.6 Enter 0100 into 4A2-A6-R155. The top part of switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.

6.2.14.5.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the MG Stabilization Loop.

CAUTION: If the transient caused by the step input does not die within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.

6.2.14.5.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.

6.2.14.5.9 Enter 0000 into 4A2-A6-R155. The top part of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press XEQ/SEAL pushbutton to remove the step input to the MG stabilization loop.

6.2.14.5.10 After the transients have died out, stop the analog recorder. Record the stab loop response time by measuring the time interval between removing the step input and the settling of the error signals to a value equal to ± 5 percent of the original step amplitude. In addition, record the total number of overshoots.

6.2.14.5.10.1 The middle gimbal stabilization loop response time shall be less than 0.1 second.

6.2.14.5.10.2 The maximum number of overshoots on the MGA Servo Error signals shall be three.

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6.2.14.6 Outer Gimbal Response Test

6.2.14.6.1 Enter code 2026000000 in C-START Module 4A1-A5-C156. Press XEQ/SEAL Pushbutton to call up OG 2177 OGA SERVO ERROR on 4A1-A3-CH1.

6.2.14.6.2 Enter VERB 41 NOUN 20 into K148. Press ENTER.

6.2.14.6.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.

6.2.14.6.4 Enter VERB 42 into K148. Press ENTER pushbutton.

6.2.14.6.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.

6.2.14.6.6 Enter 0010 into 4A2-A6-R155. The top half of the switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.

6.2.14.6.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DG step into the OG Stabilization Loops.

NOTE: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.

6.2.14.6.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.

6.2.14.6.9 Enter 0000 into 4A2-A6-R155. The top half of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the OG Stabilization Loop.

6.2.14.6.10 After the transients have died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step input and the settling of the error signal to a value equal to ± 5 percent of the original step amplitude; in addition, record the total number of overshoots.

6.2.14.6.10.1 The outer gimbal stabilization loop response time shall be less than 0.1 second.

6.2.14.6.10.2 The maximum number of overshoots on the OGA Servo Error Signals shall be five.

6.2.14.7 Enter VERB 40 NOUN 20 into K148. Press the ENTER pushbutton.

6.2.14.7.1 Enter VERB 41 NOUN 20 into K148. Press the ENTER pushbutton.

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6.2.14.7.2 Enter +00000 into K148. Press the ENTER pushbutton.

6.2.14.7.3 Enter +00000 into K148. Press the ENTER pushbutton.

6.2.14.7.4 Enter +00000 into K148. Press the ENTER pushbutton.

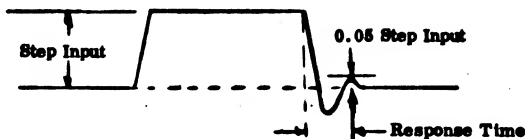


Figure 1. Typical Step Input Response

6.2.14.7.5 Enter 0000 into R154. Verify and execute to remove +28 VDC ACE ENABLE.

6.2.15 IRIG Scale Factor Test

6.2.15.1 Perform Master Initialization 6.2.5.3 before proceeding.

6.2.15.2 Verify that the IMU OPERATE power has been applied for a minimum of 1 hour, and that at least 1 hour has elapsed since running of the Gimbal Friction Test, 6.2.7.

6.2.15.3 Set up the Analog Recorders to monitor the following signals:

- a. CG 2117 IG SERVO ERROR
- b. CG 2147 MG SERVO ERROR
- c. CG 2177 OG SERVO ERROR
- d. CG 2120 IG TM CURRENT
- e. CG 2150 MG TM CURRENT
- f. CG 2180 OG TM CURRENT

6.2.15.3.1 Start the analog recorder chart drive using a chart speed of 1 mm/sec. The recorder shall run for the duration of 6.2.15.

6.2.15.4 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.15.5 Enter 00005 into K148. Press the ENTER pushbutton. Program 07 shall be displayed.

6.2.15.6 VERB 06 NOUN 61 shall flash on CRT and the following displayed in R1 and R2:

R1 = XXXXXX (some Nav. Base azimuth)

R2 = XXXXXX (some test site latitude; see Table I)

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- 6.2.15.7 If the values displayed in R1 and R2 are correct, proceed with test, if not perform the following sequence:
- To correct R1, on the K-start enter VERB 21, press ENTER pushbutton, ~~xxxx.xx~~, press ENTER (~~xxxx.xx~~ is correct nav. base azimuth).
 - To correct R2, on the K-start enter VERB 22, press ENTER pushbutton, ~~xxx.xxx~~, press ENTER (obtain correct site latitude from Table I).
- Verify values in R1 and R2 are correct.

Table I

<u>Site</u>	<u>Latitude</u>
NAA	+33.921
MSC	+29.556
MILA	+28.516

- 6.2.15.9 On K-148 enter the following sequence:
- VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
+00001 ENTR
- NOTE: If PROG lamp changes from 07 to 00 during next step or PROG ALARM is on, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.8.
- 6.2.15.9 In approximately 160 seconds VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (+X IRIG Scale Factor error in part per million, Position +00001).
- 6.2.15.10 On K-148 enter the following sequence:
- VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
+00002 ENTR
- NOTE: If PROG lamp changes from 07 to 00 during next step or PROG ALARM lamp is on, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.7 and 6.2.15.10.
- 6.2.15.11 In approximately 160 seconds VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (+Y IRIG Scale Factor error in parts per million Position +00002).
- 6.2.15.12 On K-148 enter the following sequence:
- VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
+00003 ENTR
- NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM lamp is ON, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.7 and 6.2.15.12.

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- 6.2.15.13 In approximately 160 seconds VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (-Z IRIG Scale Factor error in parts per million, position +00003).
- 6.2.15.14 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
-00001 ENTR
NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM lamp is on, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.7 and 6.2.15.14.
- 6.2.15.15 In approximately 160 seconds, VERB 05 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (-X IRIG Scale Factor error in parts per million, Position -00001).
- 6.2.15.16 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
-00002 ENTR
NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM lamp is ON, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.7 and 6.2.15.16.
- 6.2.15.17 In approximately 160 seconds, VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (-Y IRIG Scale Factor error in parts per million, Position -00002).
- 6.2.15.18 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
-00003 ENTR
NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM is ON, enter VERB 36 ENTR and repeat steps, 6.2.15.4 through 6.2.15.7 and 6.2.15.18.
- 6.2.15.19 In approximately 160 seconds, VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (+Z IRIG Scale Factor error in parts per million, Position -00003).
- 6.2.15.20 Repeat steps 6.2.15.8 through 6.2.15.19 twice to obtain second and third set of data.
- 6.2.15.21 Terminate this test by entering in K-148: VERB 34 ENTR
- 6.2.15.22 The average of the three readings of Scale Factor Error for each of the 6 positions shall be 0±1750 PPM.

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- 6.2.16 IMU Performance Test
- 6.2.16.1 Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.16.2 Enter VERB 01 NOUN 10 into K148. Press the ENTER pushbutton. Enter 00003 into K148. Press the ENTER pushbutton. Record R1 = AAAAA and the time of day.
- 6.2.16.3 Enter VERB 21 NOUN 02 into K148. Press the ENTER pushbutton. Enter 01300 into K148. Press ENTER. Enter AAAAA into K148. Press ENTER.
- 6.2.16.4 Enter VERB 06 NOUN 02 into K148. Press ENTER. Enter 01300 into K148. Press ENTER. Record R1 = BBBB.
- 6.2.16.5 Perform the following calculations:
- $R1 (BBBB) \times 5.12 = CCCC.C$ (hrs. in high order scaler channel 3)
3600
 - 23.3 - CCC.C = DDDDD Hrs.
 - Add DDDDD to time of day recorded in step 1.
- Do Not enter any of the PIPA scale factor tests within -0.2 hours of the time of day calculated in step 6.2.16.5c. This is the time at which the high order scaler, channel 3, will overflow. If a PIPA scale factor test is being performed at this time, unacceptable test results will occur.
- 6.2.16.6 Verify that the IMU Operate Power has been applied for at least one hour.
- 6.2.16.7 Test Initiation.
- 6.2.16.7.1 Enter the following into K148.
- VERB 01 NOUN 01, ENTER
 - 00362, ENTER
Record R1 = XXXXY
- 6.2.16.7.2 Enter the following into K148
- VERB 21 NOUN 01, ENTER
 - 00362, ENTER
 - XXXXY', ENTER where Y' is determined by Table XV and XXXX is that recorded in 6.2.16.7.1.

TABLE XV

Y (from 6.2.16.7.1)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

- 6.2.16.7.3 Enter VERB 57 into K148. Press the ENTER pushbutton.
- 6.2.16.7.4 Enter 00001 into K148. Press the ENTER pushbutton.
- 6.2.16.7.5 On the CRT, DSKY display verify R1 (Navigation Base Azimuth) and R2 (Site Latitude) are correct.

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- 6.2.16.7.6 If values for R1 and R2 are correct, proceed to next step. If values for R1 and R2 are incorrect, enter the following sequence into K-148.

VERB 24 ENTR

+XXX.XX ENTR (Correct navigation base azimuth ± 0.50 deg)

+XX.XXX ENTR (Correct site latitude from Table XX)

Verify values in R1 and R2 are correct

TABLE XX

LOCATION

LATITUDE

NAA

+33.921

MSC

+29.556

MILA

+28.516

- 6.2.16.7.7 On K-148 enter the following sequence:

VERB 33 ENTR

VERB 06 NOUN 66 shall flash

- 6.2.16.7.8 On CRT, DSKY display, verify R1 = +00900 (Time), R2 = +00000 (Test Index No.) and R3 = +00001 (Test Position). If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR

+00900 ENTR (Test Time in Seconds)

+00000 ENTR (Test Index Number)

+00001 ENTR (Test Position Entry)

- 6.2.16.7.9 On K-148 enter the following sequence:

VERB 33 ENTR

- 6.2.16.7.10 In approximately 17 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (+NBDY) Position +00001.

- 6.2.16.7.11 On K-148 enter the following sequence:

VERB 33 ENTR

- 6.2.16.7.12 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT, record R1 and R2 (+X PIPAS) Position +00001. Row 1 is whole part, Row 2 is fractional part, Units are cm/sec.

6.2.16.7.13 On K-148 enter the following sequence:

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6.2.16.7.13 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.2.16.7.14 On CRT DSKY displays, verify R1 = +00900, R2 = +00000, and R3 = +00002.

If values for R1, R2 and R3 are correct, proceed to next step.
If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00002 ENTR (Test Position Entry)

6.2.16.7.15 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.16 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (+NBDZ) Position +00002.

6.2.16.7.17 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.18 In approximately 90 secs. VERB 06 NOUN 66 shall flash. From the CRT, record R1 and R2 (-X PIPAG) Position +00002.

6.2.16.7.19 On K-148 enter the following sequence:

VERB 21 NOUN 01 ENTR
00407 ENTR
77757 ENTR
VERB 21 NOUN 01 ENTR
00411 ENTR
00020 ENTR
VERB 33 ENTR

6.2.16.7.20 In approximately 67 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (-NBDX + ADIAX) Pos +00002, Record CRT CDU gimbal angle indications and time.

6.2.16.7.21 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

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6.2.16.7.22 On CRT, DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00003.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00003 ENTR (Test Position Entry)

6.2.16.7.23 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.24 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (-NBDX) Position +00003.

6.2.16.7.25 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.26 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R1 and R2 (+Z PIPAG) Position +00003.

6.2.16.7.27 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.2.16.7.28 On the CRT, DSKY display verify R1 = +00900, R2 = 00000, and R3 = +00004.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00004 ENTR (Test Position Entry)

6.2.16.7.29 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.30 In approximately 17 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (+NBDY +ADSRAY) Position +00004.

6.2.16.7.31 On K-148 enter the following sequence:

VERB 33 ENTR

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- 6.2.16.7.32 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R1 and R2 (-Z PIPAG) Position +00004.
- 6.2.16.7.33 On K-148 enter the following sequence:
- VERB 21 NOUN 01 ENTR
00405 ENTR
00020 ENTR
VERB 21 NOUN 01 ENTR
00407 ENTR
77757 ENTR
VERB 33 ENTR
- 6.2.16.7.34 In approximately 67 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R2 (+NBDZ + ADIAZ) Position +00004. Record CRT CDU gimbal angle indications and time.
- 6.2.16.7.35 On K-148 enter the following sequence:
- VERB 33 ENTR
VERB 06 NOUN 66 shall flash
- 6.2.16.7.36 From the CRT DSKY display, verify R1 = +00900, R2 = +00000 and R3 = +00005.
- If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:
- VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00005 ENTR (Test Position Entry)
- 6.2.16.7.37 On K-148 enter the following sequence:
- VERB 33 ENTR
- 6.2.16.7.38 The PROG alarm and GIMBAL LOCK lamps shall light. Press Error Reset. The PROG alarm lamp shall extinguish.
- 6.2.16.7.39 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R1 and R2 (+Y PIPAG) Position +00005.
- 6.2.16.7.40 On K-148 enter the following sequence:
- VERB 34 ENTR
VERB 06 NOUN 66 shall flash

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VERB 04 ENTR
VERB 06 NOUN 66 shall flash

- 6.2.16.7.41 On the CRT DSKY display, verify R1 = +00900, R2 = +00000 and R3 = +00006.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2, and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00006 ENTR (Test Position Entry)

- 6.2.16.7.42 On K-148 enter the following sequence:

VERB 33 ENTR

- 6.2.16.7.43 The PROG alarm and GIMBAL LOCK lamps shall light. Press Error Reset. The PROG alarm lamp shall extinguish.

- 6.2.16.7.44 In approximately 90 secs VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R1 and R2. (-Y PIPAG) Position +00006.

- 6.2.16.7.45 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

- 6.2.16.7.46 On the CRT DSKY display, verify R1 = +00900, R2 = +00000 and R3 = +00007.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2, and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00007 ENTR (Test Position Entry)

- 6.2.16.7.47 On K-148 enter the following sequence:

VERB 33 ENTR

- 6.2.16.7.48 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (+.707 ADSRAX-NBDX) Position +00007.

- 6.2.16.7.49 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

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6.2.16.7.50 On the CRT DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00008.

6.2.16.7.51 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.52 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 [-.707 (NBDZ+NBDY) +0.5 (ADIAZ-ADIA Y) +0.5 (ADERAY + ADSRAZ)] Position +00008.

6.2.16.7.53 On K-148 enter the following:

VERB 34 ENTR

VERB 06 NOUN 66 shall flash

6.2.16.7.54 On the CRT DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00009.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR

+00900 ENTR (Test Time in Seconds)

+00000 ENTR (Test Index Number)

+00009 ENTR (Test Position Entry)

6.2.16.7.55 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.56 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (-NBDZ +.707 ADSRAZ) Position +00009.

6.2.16.7.57 On K-148 enter the following sequence:

VERB 34 ENTR

VERB 06 NOUN 66 shall flash

6.2.16.7.58 On the CRT DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00010.

If values for R1, R2, and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR

+00900 ENTR (Test Time in Seconds)

+00000 ENTR (Test Index Number)

+00010 ENTR (Test Position Entry)

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6.2.16.7.59 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.60 In approximately 12 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R2 [707 (NBDY-NBDX) +.5 (ADLAY-ADIAX) +.5 ADSRA ☒ Position +00010.

6.2.16.7.61 Terminate this test by entering in K-148 the following:

VERB 36 ENTR

6.2.16.7.62 On K-148 enter the following sequence:

VERB 41 NOUN 20 ENTR

+00000 ENTR

+00000 ENTR

+00000 ENTR

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6.2.16.10 Calculations

Table XXI

Position No. As Displayed in R3	Quantity Being Measured
+00001	+NBDY +X PIPA G
+00002	+NBDZ -X PIPA G -NBDK + ADIAX
+00003	-NBDK +Z PIPA G
+00004	+NBDY + ADSRAY -Z PIPA G +NBDZ + ADIAZ
+00005	+ Y PIPA G
+00006	- Y PIPA G
+00007	-NBDK + .707 ADSRAX
+00008	.707 (-NBDZ - NBDY) + .5 (ADIAZ - ADIAX) +.5 (ADSRAX + ADSRAZ)
+00009	-NBDZ + .707 ADSRAZ
+00010	.707 (NBDY - NBDK) + .5 (ADIAX - ADIAX) +.5 (ADSRAX)

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6.2.16.10.1 Measured Values

<u>Line</u>	<u>Position No.</u>	<u>Step No.</u>	<u>Parameter</u>	<u>Recorded Value</u>
6.2.16.10.1.1	1	+00001	6.2.16.7.10 +NBDY	R2
6.2.16.10.1.2	2	+00001	6.2.16.7.12 +XPIPAG	R1 . R2
6.2.16.10.1.3	3	+00002	6.2.16.7.10 +NBDZ	R2
6.2.16.10.1.4	4	+00002	6.2.16.7.10 -XPIPAG	R1 . R2
6.2.16.10.1.5	5	+00002	6.2.16.7.20 -NBDX + ADIAX	R2
6.2.16.10.1.6	6	+00003	6.2.16.7.24 -NBDX	R2
6.2.16.10.1.7	7	+00003	6.2.16.7.20 +ZPIPAG	R1 . R2
6.2.16.10.1.8	8	+00004	6.2.16.7.20 +NBDY + ADSRAY	R2
6.2.16.10.1.9	9	+00004	6.2.16.7.20 -ZPIPAG	R1 . R2
6.2.16.10.1.10	10	+00004	6.2.16.7.30 +NBDZ + ADIAZ	R2
6.2.16.10.1.11	11	+00005	6.2.16.7.30 +YPIPAG	R1 . R2
6.2.16.10.1.12	12	+00006	6.2.16.7.40 -YPIPAG	R1 . R2
6.2.16.10.1.13	13	+00007	6.2.16.7.40 -NBDX + .707ADSRAX	R2
6.2.16.10.1.14	14	+00008	6.2.16.7.80 .707 (-NBDZ - NBDY) + .5 (ADIAZ - ADIAX) + .5 (ADSRAX + ADSRAZ)	R2
6.2.16.10.1.15	15	+00009	6.2.16.7.80 -NBDZ + .707ADSRAX	R2
6.2.16.10.1.16	16	+00010	6.2.16.7.80 .707 (NBDY - NBDX) + .5 (ADIAX - ADIAX) + .5 ADSRAZ	R2

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6.2.16.10.2 Obtain data from last historical IRIG and PIPA test and complete Table X_{I-1}.

TABLE X_{I-1}

PARAMETER	UNITS	RECORDED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIAX	meru/g	
ADIAY	meru/g	
ADIAZ	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

6.2.16.10.3 Obtain data from the second last historical IRIG and PIPA test and complete Table X_{I-2}.

TABLE X_{I-2}

PARAMETER	UNITS	RECORDED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIAX	meru/g	

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TABLE X₁₋₂ (Continued)

PARAMETER	UNITS	RECORDED VALUE
ADIAI	meru/g	
ADIAZ	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

6.2.16.10.4 Obtain data from the third last historical IRIG and PIPA test and complete Table X₁₋₃.

TABLE X₁₋₃

PARAMETER	UNITS	RECORDED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIAI	meru/g	
ADIAZ	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

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6.2.16.10.5 Compute the PIPA Scale Factor error in parts per million and record in Table X.

$$a. \text{ PIPA S. F. Error} = \left[\frac{(2 \text{ local g})}{+PIPAG - (-PIPAG)} - 1.000000 \right] 10^6$$

$$b. \text{ X PIPA S. F. Error} = \left[\frac{(2 \text{ local g})}{\text{line 2} - \text{line 4}} - 1.000000 \right] 10^6$$

$$c. \text{ Y PIPA S. F. Error} = \left[\frac{(2 \text{ local g})}{\text{line 11} - \text{line 12}} - 1.000000 \right] 10^6$$

$$d. \text{ Z PIPA S. F. Error} = \left[\frac{(2 \text{ local g})}{\text{line 7} - \text{line 9}} - 1.000000 \right] 10^6$$

The PIPA S. F. Error shall not exceed ± 1000 PPM.

6.2.16.10.6 Compute the PIPA Bias in cm/sec^2 and record in Table X₁.

$$a. \text{ PIPA Bias} = \frac{+PIPAG + (-PIPAG)}{2} = \text{--- cm/sec}^2$$

$$b. \text{ X PIPA Bias} = \frac{\text{line 2} + \text{line 4}}{2} =$$

$$c. \text{ Y PIPA Bias} = \frac{\text{line 11} + \text{line 12}}{2} =$$

$$d. \text{ Z PIPA Bias} = \frac{\text{line 7} + \text{line 9}}{2} =$$

The PIPA Bias shall not exceed $\pm 2.28 \text{ cm/sec}^2$.

6.2.16.10.7 Calculate NBD, ADSRA, and ADIA and record in Table X₁.

$$a. \text{ NBDX} = -(\text{line 6}) =$$

$$\text{NBDY} = \text{line 1} =$$

$$\text{NBDZ} = \text{line 3} =$$

NBD shall not exceed ± 15 meru.

$$b. \text{ ADSRAX} = \frac{(\text{line 13} - \text{line 6})}{.707} =$$

$$\text{ADSRAY} = \text{line 6} - \text{line 1}$$

$$\text{ADSRAZ} = \frac{\text{line 15} + \text{line 3}}{.707}$$

ADSRA shall not exceed ± 40 meru/g.

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c. ADIAX = line 5 - line 6

ADIAZ = line 16 - .707 (NBDY-NBDX) - .5 (ADSRAX-ADIAZ)
.5

ADIAZ = line 10 - line 3

ADIA shall not exceed ± 100 meru/g.

TABLE X₁

PARAMETER	UNITS	CALCULATED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRZ	meru/g	
ADIAZ	meru/g	
ADIAZ	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

6.2.16.10.8 Perform the following calculations for each term in Table X₁, and record the results in Table D.

$$D_1 = |X_{i-1} - X_i|$$

$$D_2 = |X_{i-1} - X_i| + |X_{i-2} - X_{i-1}|$$

$$D_3 = |X_{i-3} - X_{i-2}| + |X_{i-2} - X_{i-1}| + |X_{i-1} - X_i|$$

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- X_1 = data point just obtained
 X_{1-1} = last historical data point
 X_{1-2} = second last historical data point
 X_{1-3} = third last historical data point

NOTE: D_1 calculations begin with the first data point after ISS Pre-Vib; D_2 calculations begin with the second data point after ISS Pre-Vib; D_3 calculations begin with the third data point after Pre-Vib.

TABLE D

PARAMETER	UNITS	D_1	MAX	D_2	MAX	D_3	MAX
NBDX	meru		6		9	-	11
NBDY	meru		6		9		11
NBDZ	meru		6		9		11
ADSRAX	meru/g		14		21		25
ADSRAY	meru/g		14		21		25
ADSRAZ	meru/g		14		21		25
ADLAX	meru/g		17		33		40
ADLAY	meru/g		17		33		40
ADLAZ	meru/g		17		33		40
X PIPA S. F. Error	PPM		400		500		600
Y PIPA S. F. Error	PPM		400		500		600
Z PIPA S. F. Error	PPM		400		500		600
X PIPA Bias	cm/sec ²		0.5		0.7		0.9
Y PIPA Bias	cm/sec ²		0.5		0.7		0.9
Z PIPA Bias	cm/sec ²		0.5		0.7		0.9

6.2.16.10.9 Failure to meet the above criteria shall result in retest according to paragraph 5.4.2.

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6.2.17.1 EXT-NB-IMU Fine Alignment Test

6.2.17.1 Perform Master Initialization 6.2.5.3 before proceeding.

6.2.17.2 Prior to performing this test, the G&N Installation Qualification fixture shall be installed on the supporting fixture and adjusted to permit proper operation of the G&N optics. The azimuth supplied by the azimuth autoset (Optical Reference No. 1) shall be known to ± 30 minutes of arc.

NOTE: The G&N shall have had OPERATE power applied for a minimum of 1 hour. Set the G/N POWER-OPTICS switch to OPTICS. Verify that ± 28 VDC OPTICS OPERATE BUS (CG 1530) is $\pm 28.0 \pm 3.0$ VDC. Verify that the OPTX 28V 800 cps 1% zero (CG1211) and OPTX 28V 800 cps 5%-20 ph (CG 1212) are not flashing on the CRT.

6.2.17.3 Enter VERB 01 NOUN 10 into K148. Press the ENTER pushbutton. Enter 00003 into K148. Press the ENTER pushbutton. Record R1 = AAAAA.

If the recorded value is within any of the sets of limits given in Table 1 proceed with the test. If the recorded value is NOT within any of the sets of limits wait 30 minutes and then repeat this step.

TABLE 1

MIN VALUE			MAX VALUE
00000	<	AAAAA	< 03242
04000	<	AAAAA	< 07242
10000	<	AAAAA	< 13242
14000	<	AAAAA	< 17242
20000	<	AAAAA	< 23242
24000	<	AAAAA	< 27242
30000	<	AAAAA	< 33242
34000	<	AAAAA	< 37242

6.2.17.4 Enter the following sequence into the Lower Equipment Bay (LEB) DSKY.

- VERB 41 NOUN 20 ENTER
- +00000, ENTER
- +00000, ENTER
- +00000, ENTER

6.2.17.5 On the G&N Indicator Control Panel set the following switches to the position indicated.

- OPTICS TEL TRUN to SLAVE to EXT EXT
- OPTICS COUPLING to DIRECT
- OPTICS SPEED to LO to LO
- OPTICS MODE to MAN
- OPTICS ZERO to ZERO

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6.2.17.6 Enter the following into the DSKY.

- a. VERB 01 NOUN 01, ENTER
- b. 00362, ENTER
- Record R1 = XXXXY

6.2.17.7 Enter the following into the DSKY

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table II and XXXX is that recorded in 6.2.17.9.

TABLE II

Y (From 6.2.17.9)	0	1	2	3	4	5	6	7
Y'	2	3	2	2	6	7	6	7

6.2.17.8 Initiate the test by entering the following sequence into the LEB DSKY.

- a. VERB 57, ENTER
- b. 00003, ENTER

6.2.17.9 Observe VERB 06 NOUN 01 flashing on the DSKY. The following data is displayed in R1 and R2 on the DSKY.

- a. R1 = +13500
- b. R2 = +xx.xxx (Site Latitude from Table I)

TABLE I

Test Site	Latitude
NAA	+33.922
MILA	+28.516
MSC	+29.556

6.2.17.10 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If the value displayed is other than +13500 in R1 and the correct Site Latitude in R2, correct the data by entering the following sequence into the DSKY.

- a. VERB 21, ENTER
- b. +13500, ENTER
- c. VERB 22, ENTER
- d. +xx.xxx, ENTER (+xx.xxx = Site Latitude from Table I)
- e. VERB 33, ENTER

6.2.17.11 Observe VERB 21 NOUN 30 flashing on the DSKY. Enter the following sequence into the DSKY.

- a. +00001, ENTER (Position Number)
- b. +00000, ENTER
- c. +00001, ENTER

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- 6.2.17.13 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- a. R1 = +xxx.xx (YNB Azimuth)
 - b. R2 = +xx.xx (YNB Elevation)
 - c. R3 = 00001
- 6.2.17.13 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct YNB azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- a. VERB 24, ENTER
 - b. +xxx.xx ± 002.00 degrees, ENTER (YNB azimuth)
 - c. +xx.xxx ± 02.000 degrees, ENTER (YNB elevation)
 - d. VERB 33, ENTER
- 6.2.17.14 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- a. R1 = +xxx.xx (ZNB Azimuth)
 - b. R2 = +xx.xx (ZNB Elevation)
 - c. R3 = 00002
- 6.2.17.15 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct ZNB azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- a. VERB 24, ENTER
 - b. +xxx.xx ± 002.00 degrees, ENTER (ZNB Azimuth)
 - c. +xx.xxx ± 02.000 degrees, ENTER (ZNB elevation)
 - d. VERB 33, ENTER
- 6.2.17.16 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- a. R1 = +xxx.xx (Target 1 Azimuth)
 - b. R2 = +xx.xx (Target 1 Elevation)
 - c. R3 = 00001
- 6.2.17.17 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct azimuth and elevation for Target 1, correct the data by entering the following sequence into the DSKY.
- a. VERB 24, ENTER
 - b. +xxx.xx ± 000.10 degrees, ENTER (Target 1 Azimuth)
 - c. +xx.xxx ± 00.010 degrees, ENTER (Target 1 Elevation)
 - d. VERB 33, ENTER
- 6.2.17.18 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- a. R1 = +xxx.xx (Target 2 Azimuth)
 - b. R2 = +xx.xx (Target 2 Elevation)
 - c. R3 = 00002

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- 6.2.17.19 If the data displayed is correct proceed to 6.2.17.20. If R1 and R2 do not contain the correct azimuth and elevation for Target 2, correct the data by entering the following sequence into the DSKY.
- a. VERB 24, ENTER
 - b. xxxx.xxxx000.10 degrees, ENTER (Target 2 Azimuth)
 - c. xxx.xxxx00.010 degrees, ENTER (Target 2 Elevation)
- 6.2.17.20 Set the OPTICS ZERO switch to OFF. Enter VERB 33, ENTER into the DSKY.
- 6.2.17.21 When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00001, set the OPTICS MODE switch on the G&N Indicator Control Panel to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.
- 6.2.17.22 Using the Optics Band Controller, align the SXT StLOS with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.23 When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00002 set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.
- 6.2.17.24 Using the Optics Hand Controller, align the SXT StLOS with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.
- NOTE: The following two MARKS must be performed as quickly as possible. In no case shall the time between the first and second MARK exceed two minutes.
- 6.2.17.25 After 90 seconds observe the DSKY for VERB 51 NOUN 30 flashing and R1 = 00001. Set the Optics Mode switch to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.
- 6.2.17.26 Using the Optics Hand Controller, align the SXT StLOS with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.

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- 6.2.17.27 When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00002 set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.
- 6.2.17.28 Using the Optics Hand Controller, align the SXT S&LOS with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.29 Repeat steps 6.2.17.27 through 6.2.17.28.
- 6.2.17.29 In approximately 7 minutes VERB 06 NOUN 66 shall flash on the DSKY and the test results shall be displayed. R1 and R2 on the DSKY shall display the misalignment of one of the horizontal PIPA's in arc seconds (R1 = whole; R2 = fractional). Record R1 and R2. (See Table II for PIPA displayed).
- 6.2.17.30 Enter VERB 33 ENTER into the DSKY. When VERB 06 NOUN 66 flashes, R1 and R2 on the DSKY shall display the misalignment of the second horizontal PIPA in arc seconds (R1 whole, R2 fractional). (See Table II for PIPA displayed.) Record R1 and R2.
- 6.2.17.31 Enter VERB 34 ENTER into the DSKY to terminate the test. Wait 5 seconds.
- 6.2.17.32 Repeat steps 6.2.17.3 and 6.2.17.8 through 6.2.17.31 substituting No. 00002 in 6.2.17.11.a.
- 6.2.17.33 Enter the following into the DSKY.
- VERB 36, ENTER
 - VERB 41 NOUN 20, ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER

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Table II. Display Conditions at Test Completion

Position	SM Orientation			Horizontal Misalignment Component	
	X _{SM}	Y _{SM}	Z _{SM}	6.2.17.20	6.2.17.30
1	UP	SW	SE	Y _{SM}	Z _{SM}
2	SE	SW	DN	X _{SM}	Y _{SM}
3*	SE	UP	SW	X _{SM}	Z _{SM}

* Position 3 is not run in the Spacecraft because of GIMBAL LOCK considerations.

6.2.17.24 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.17.25 Calculations

- a. Y_{SM} misalignment = () $\frac{R1-R2}{}$
- b. Z_{SM} misalignment = () $\frac{R1-R2}{}$
- c. X_{SM} misalignment = () $\frac{R1-R2}{}$
- d. Y_{SM} misalignment = () $\frac{R1-R2}{}$

6.2.17.26.2 Enter the latest values from 6.2.16 DMU Performance Test.

- a. X PIPA bias = _____ cm/sec²
- b. Y PIPA bias = _____ cm/sec²
- c. Z PIPA bias = _____ cm/sec²
- d. $\theta_x = 210$ (X PIPA bias) = _____ arc sec.
- e. $\theta_y = 210$ (Y PIPA bias) = _____ arc sec.
- f. $\theta_z = 210$ (Z PIPA bias) = _____ arc sec.

- 6.2.17.26.3 a. Y_{SM} misalignment (Bias corrected) = 6.2.17.26.1a - θ_y = _____ arc sec.
- b. Z_{SM} misalignment (Bias corrected) = 6.2.17.26.1b - θ_z = _____ arc sec.
- c. X_{SM} misalignment (Bias corrected) = 6.2.17.26.1c - θ_x = _____ arc sec.
- d. Y_{SM} misalignment (Bias corrected) = 6.2.17.26.1d - θ_y = _____ arc sec.

The SM misalignments in each orientation, including PIPA bias, shall not exceed ±100 arc seconds.

6.2.18 Gyrocompassing Test

NOTE: Perform Master Initialization 6.2.5.3 before proceeding.

- 6.2.18.1 Set the G/N POWER-OPTICS Switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Verify that OPTX 28V 800 cps 1% zero (CG1211) and OPTX 28V 800 cps 5% ± 90°h (CG 1212) are not flashing on the CRT.

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6.2.18.2 Enter the following into the DSKY.

- a. VERB 01 NOUN 01, ENTER
- b. 00362, ENTER
- Record R1 = XXXXY

6.2.18.3 Enter the following into the DSKY.

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table II and XXXX is that recorded in 6.2.18.2.

Table II

Y (From 6.2.18.2)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.18.4 Enter the following sequence into the K-Start, pressing ENTER pushbutton after each entry.

- a. VERB 57, ENTER
- b. 00006, ENTER

6.2.18.5 System shall advance to Gyrocompass System Test and display 01 on the CRT program display.

6.2.18.6 On the CRT observe VERB 06, NOUN 61 flashing with some launch azimuth displayed in R1 = +xxx.xx.

6.2.18.6.1 If the azimuth displayed is correct proceed to 6.2.18.5; if not, perform the following sequence:

- a. VERB 21, Press ENTER pushbutton
- b. +xxx.xx, press ENTER pushbutton (Correct Launch Azimuth)

6.2.18.7 After verifying that the correct launch azimuth is displayed in R1 on the CRT, Enter VERB 33 on the K-START and push the ENTER pushbutton.

6.2.18.8 Observe VERB 06 NOUN 61 flashing on the CRT with the following displayed in R1 and R2.

- a. R1 = +xxx.xx, Nav. Base Azimuth (Z_{NB})
- b. R2 = +xx.xxx, Site Latitude

6.2.18.8.1 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence:

To correct R1:

- a. VERB 21, ENTER
- b. +xxx.xx±000.50 degrees, ENTER (Z_{NB} Azimuth)

To correct R2:

- a. Verb 22, ENTER
- b. +xx.xxx, ENTER (Correct Site Latitude from Table I)

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6.2.18.9 Gyrocompassing Stability

6.2.18.9.1 Enter VERB 33, ENTER into the DSKY. On the DSKY observe the PROGRAM display change to 05 after approximately 90 seconds. Approximately 5 minutes later observe the PROGRAM display change to 02. When PROG display changes to 02 record time as T_0 .

6.2.18.9.2 120 minutes after T_0 record the Outer, Inner and Middle CDU Gimbal angles from the CRT.

6.2.18.9.3 Repeat above step every 5 minutes for the next 120 minutes.

6.2.18.9.4 The peak-to-peak spread of the outer gimbal angle shall not exceed 0.12 degrees.

6.2.18.9.5 The peak-to-peak spread of the Inner and Middle gimbal angles shall not exceed 0.06 degrees.

6.2.18.10 Gyrocompassing Accuracy

6.2.18.10.1 Between 235 minutes and 240 minutes from T_0 set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO.

6.2.18.10.2 Enter the following into the DSKY.

- a. VERB 21 NOUN 03 ENTER
- b. 02663 ENTER
- c. +XXX.XX ± 000.01 ENTER (Target No. 1 Az)
- d. Press ENTER Pushbutton
- e. 02664 ENTER
- f. +XXX.XX ± 000.01 ENTER (Target No. 2 Az)
- g. Press ENTER Pushbutton
- h. 02665 ENTER
- i. +00.000 ENTER (Target No. 1 EL)
- j. Press ENTER Pushbutton
- k. 02666 ENTER
- l. +00.000 ENTER (Target No. 2 EL)

On the G&N Indicator Control Panel set the OPTICS ZERO switch to OFF, set the OPTICS MODE switch to MAN and the OPTICS SPEED switch to HI. Drive the SLOS to the approximate position of Target No. 1. Set the OPTICS SPEED Switch to LO.

NOTE: Read the following 10 steps before proceeding: These are time critical steps and must be performed as rapidly as possible.

6.2.18.11 After 240 minutes from T_0 enter VERB 52 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT change to 03.

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- 6.2.18.12 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 1 azimuth and elevation.
- a. R1 = +xxx.xx (Target 1 azimuth)
 - b. R2 = +00.000 (Target 1 elevation)
- 6.2.18.13 Verify the data appearing in R1 and R2 and if correct, proceed. If not correct, perform the following sequence.
- a. VERB 24, ENTER
 - b. +xxx.xx±000.01, ENTER (Target 1 azimuth)
 - c. +00.000, ENTER (Target 1 elevation)
- 6.2.18.14 After the correct readings for R1 and R2 are verified, enter VERB 33 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.15 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 2 azimuth and elevation.
- a. R1 = +xxx.xx (Target 2 azimuth)
 - b. R2 = +00.000 (Target 2 elevation)
- 6.2.18.16 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence.
- a. VERB 24, ENTER
 - b. +xxx.xx±000.01, ENTER (Target 2 azimuth)
 - c. +00.000, ENTER (Target 2 elevation)

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- 6.2.18.17 After the correct readings for R1 and R2 are verified enter VERB 33 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.18 Using the Optics Hand Controller, align the SXT StLOS to target 1 and press the MARK pushbutton. If satisfied that the MARK was good, proceed. If not satisfied with MARK, press the MARK REJECT pushbutton and repeat the step.
- 6.2.18.19 Set the OPTICS SPEED switch to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target No. 2.
- 6.2.18.20 Set the OPTICS SPEED switch to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 2 and press the MARK pushbutton. If satisfied that the MARK was good, press the ENTER pushbutton. If not satisfied, press the MARK REJECT pushbutton and repeat this step.
- 6.2.18.21 On the CRT observe the following data displayed:
- a. VERB 06 NOUN 60
 - b. R1 = \pm xx.xxx (X gyro elevation error, degrees)
 - c. R2 = \pm xx.xxx (Y gyro elevation error, degrees)
 - d. R3 = \pm xx.xxx (Z gyro azimuth error, degrees)
- Record R1, R2 and R3.
- 6.2.18.22 Enter VERB 34 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT and DSKY's indicate 02. Set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.23 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.24 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start three times. Press the ENTER pushbutton after each entry. Set the G/N POWER OPTICS Switch on the LEB Lighting Control Panel to OFF.

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6.2.18.25 Data Sheet

TIME	CDUX	CDUY	CDUZ
To			
To +15			
To +30			
To +45			
To +60			
To +75			
To +90			
To +105			
To +120			
To +125			
To +130			
To +135			
To +140			
To +145			
To +150			
To +155			
To +160			
To +165			
To +170			
To +175			
To +180			

- NOTES: 1. Record CDU angles at times indicated. (T_0 is the time at the start of test - Prog 02)
2. The 2 hr data ($T_0 + 120$ minutes) is baseline.

Tolerance: Tolerance is $0.00 \pm 0.06^\circ$ delta from 2 hr baseline for CDUX, and $0.00 \pm 0.03^\circ$ delta from 2 hr baseline for CDUY & CDUZ for the 120 minute to 180 minute recordings only.

Line	Step	Parameter	Recorded Value
1	6.2.18.21	X Gyro Elevation Error	$\pm R1$ degrees
2		Y Gyro Elevation Error	$\pm R2$ degrees
3		Z Gyro Azimuth Error	$\pm R3$ degrees

6.2.18.26 Calculation Sheet

6.2.18.26.1 Record the most recent values of the following coefficients from 6.2.16, IMU Performance Test.

- a. NBDX = () _____
- b. NBDY = () _____
- c. NBDZ = () _____
- d. ADIAZ = () _____
- e. ADSRAY = () _____

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6.2.18.26.2 Perform the following calculations. (Cos λ functions are provided in Table I.)

a. $D_{(vert)} = NBDZ + ADIAZ$

$D_{(vert)} = () \text{ } \underline{\hspace{2cm}} \text{ } meru$

b. $D_{(east)} = \sin(\text{Launch Az}) NBDX + \cos(\text{Launch Az}) NBDY + ADSRAY$

c. $\phi_{(vert)} = D_{(vert)} \times \frac{12.8}{3600} + D_{(east)} \times \frac{206}{\cos \lambda}$

$\phi_{(vert)} = () \text{ } \underline{\hspace{2cm}} \text{ } \text{degrees}$

Table I

Location	Latitude λ	Cos λ
NAA	33.921	0.82985
MILA	28.516	0.87868
MSC	29.556	0.86993

6.2.18.26.3 Perform the following calculations using the recorded data from 6.2.18.25 and 6.2.18.26.2.

a. Z Gyro azimuth error 3 hrs (corrected) = line 3 - $\phi_{(vert)}$
Z Gyro azimuth error 3 hrs (corrected) = $\underline{\hspace{2cm}}$ corrected
Z Gyro azimuth error (corrected) shall be 0.00 \pm 0.573 degrees.

b. X Gyro elevation error (3 hr) = line 1 $\underline{\hspace{2cm}}$
X Gyro elevation error (3 hr) = $\underline{\hspace{2cm}}$ degrees

c. Y Gyro elevation error (3 hr) = line 2 $\underline{\hspace{2cm}}$
Y Gyro elevation error (3 hr) = $\underline{\hspace{2cm}}$ degrees
The X and Y Gyro elevation errors shall be 0.00 \pm 0.045 degrees.

6.2.19 CMC Voltage Margin Test

6.2.19.1 Verify that the G&N IMU HTR MNA and MNB breakers are engaged, computer MNA and MNB breakers are engaged, IMU MNA and MNB breakers are not engaged, and the G&N Power-IMU switch on the LEB Lighting Control Panel is in the OFF position.

6.2.19.2 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to ON.

CAUTION: During the performance of this test the +4 VDC CMC Power Supply shall not be operated at less than +2.5 VDC or greater than 5.2 VDC (CG 1030). The +14 VDC CMC Power Supply shall not be operated at less than +8.5 VDC or greater than +17.0 VDC (CG 1020). Rotate the LEB LTS NUMERICS SEL to approximately center position. Decrease to absolute minimum

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6.2.19.2
(cont)

discernible lighting.

NOTE: The flashing indication of the CMC Power Supplies on CRT may be disregarded for this test. The charts in Table I may be used to determine approximate values for the "XX.X" values of C-156 voltage dial settings corresponding to various power supply voltages.

6.2.19.3

Units R-154, insert 0001. Verify and execute.

6.2.19.4

Insert in C-156, -040001244 and execute. Verify on CRT that GV0116 is between -3.0 and -5.0 vdc.

6.2.19.5

Insert in C-156 -050001234 and execute. Verify on CRT that GV0106 is between -4.0 and -6.0 vdc.

6.2.19.6

Units R-154, insert 0111. Verify and execute.

6.2.19.7

Observe CG 1020, +14 VDC Power Supply, and CG 1030, +4 VDC Power Supply on CRT. Repeat 6.2.19.3 through 6.2.19.6 adjusting each C Start entry until CG 1020 is 12.1, +0.1, -0.0 vdc and CG 1030 is 3.40, +0.03, -0.00 vdc.

6.2.19.8

Initiate CMC Self Check by inserting the following in K-148.

- a. ERROR RESET
- b. VERB 21, NOUN 27, ENTER
- c. 77777, ENTER

Wait 200 seconds.

6.2.19.9

Insure that the DSKY RESTART lamp does not light, and that

- a. VERB 05 NOUN 31
- b. R1 = 01102

does not appear on DSKY.

6.2.19.10

Set INHIBIT VOLTAGE FAIL switch to OFF on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. If RESTART lamp does not light, repeat 6.2.19.3. Verify CMC Warning master alarms are lighted.

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- 6.2.19.11 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- ERROR RESET
 - VERB 21, NOUN 27, ENTER
 - 77777, ENTER
- 6.2.19.12 Units R-154, insert 0001. Verify and execute.
- 6.2.19.13 Insert in C-156 +108001244 and execute. Verify on CRT that GV0116 is between +0.8 and +11.8 vdc.
- 6.2.19.14 Units R-154, insert 0111. Verify and execute.
- 6.2.19.15 Observe CG 1020, +14 VDC Power Supply on CRT. Repeat 6.2.19.12 through 6.2.19.14 adjusting the C Start entry until CG 1020 is 16.4, +0.0, -0.1 vdc.
- 6.2.19.16 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- VERB 05, NOUN 31
 - R1 = 01102
- does not appear on DSKY.
- 6.2.19.17 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted. ~~Insert into K-148, 6.2.19.17 Pressing the 1020 and CG 1020 at PSAAM interface instead of CRT.~~
- 6.2.19.18 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- ERROR RESET
 - VERB 21, NOUN 27, ENTER
 - 77777, ENTER
- 6.2.19.19 Units R-154, insert 0001. Verify and execute.
- 6.2.19.20 Insert in C-156, +092001234 and execute. Verify on CRT that GV0106 is between +8.2 and +10.2 vdc.
- 6.2.19.21 Units R-154, insert 0111. Verify and execute.
- 6.2.19.22 Observe CG 1030, +4 VDC Power Supply on CRT. Repeat 6.2.19.19 through 6.2.19.21 adjusting the C Start entry until CG 1030 is 4.60, +0.00, -0.03 vdc.
- 6.2.19.23 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- VERB 05, NOUN 31
 - R1=01102
- does not appear on DSKY.

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- 6.2.19.24 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted. ~~Observe CG 1020 as PSAAM indication instead of CRT.~~ Observe CG 1020 as PSAAM indication instead of CRT.
- 6.2.19.25 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- ERROR RESET
 - VERB 21, NOUN 27, ENTER
 - 77777, ENTER.
- 6.2.19.26 Units R-154, insert 0001. Verify and execute.
- 6.2.19.27 Insert in C-156, -040001244 and execute. Verify on CRT that GV0116 is between -3.0 and -5.0 vdc.
- 6.2.19.28 Units R-154, insert 0111. Verify and execute.
- 6.2.19.29 Observe CG 1020, +14 VDC Power Supply on CRT. Repeat 6.2.19.26 through 6.2.19.28 adjusting the C Start entry until CG 1020 is 12.1, +0.1, -0.0 vdc.
- 6.2.19.30 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- VERB 05, NOUN 31
 - R1 = 01103
- does not appear on DSKY.
- 6.2.19.31 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted. ~~Observe CG 1020 as PSAAM indication instead of CRT.~~ Observe CG 1020 as PSAAM indication instead of CRT.
- 6.2.19.32 Units R-154, insert 0000. Verify and execute.
- 6.2.19.33 Terminate CMC Self-Check by inserting into K-148:
- ERROR RESET
 - VERB 21, NOUN 27, ENTER
 - 00000, ENTER
- 6.2.19.34 Ensure that CG 1020, +14 VDC Power Supply indication is +14.0, ± 0.4 , and that CG 1030, +4 VDC Power Supply indication is +4.00 ± 0.20 VDC on CRT.

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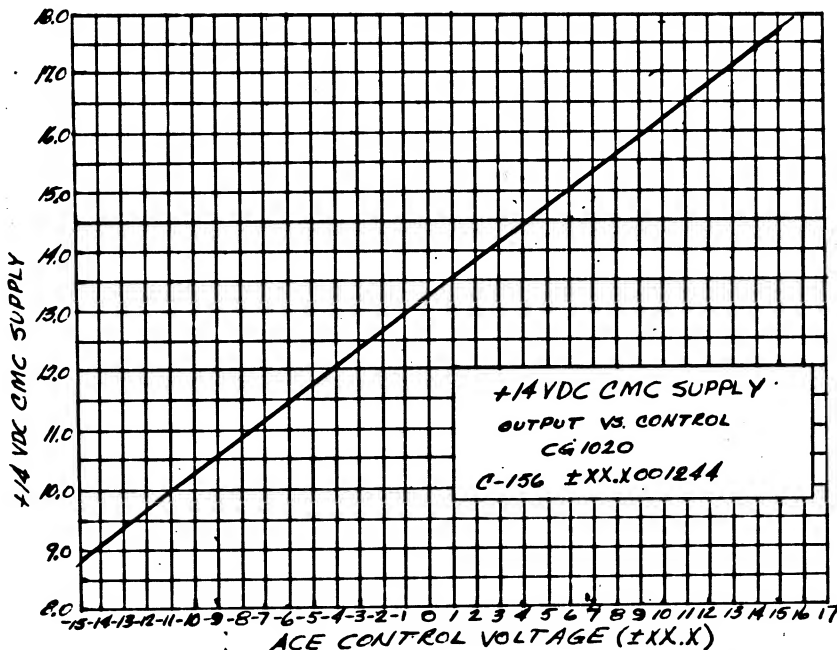
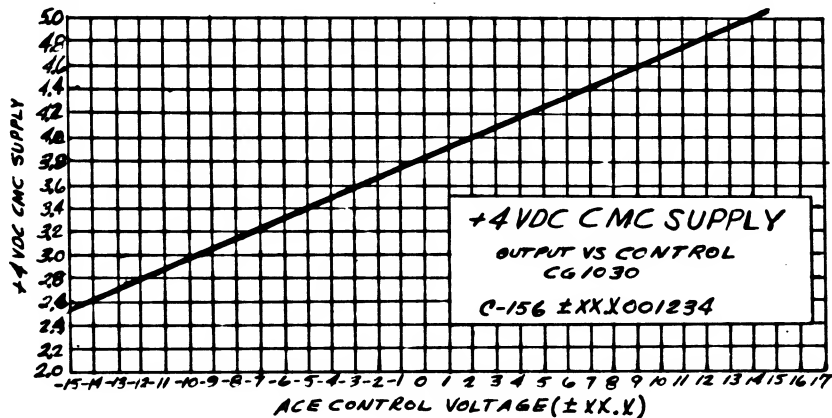


TABLE I

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6.2.20 Spacecraft Control and Displays Test

6.2.20.1 Perform Master Initialization before proceeding. If system operation is not successful, proceed to the next step in the sequence.

6.2.20.2 FDAI Attitude Error

6.2.20.2.1 Insert in K148

- a. V 57 ENTER
- b. 00013 ENTER

6.2.20.2.2 Observe on CRT

- a. V 06 NO1 Flashing
- b. PROG 07
- c. NO ATT ON
- d. R1, R2, and R3 Approx. 00000

6.2.20.2.3 Insert in K148

- a. VERB 33, ENTER

6.2.20.2.4 Observe on CRT

- a. V 06 NO1 Flashing
- b. R1 +00385
- c. R2 -00385
- d. R3 +00385
- e. NO ATT OFF

6.2.20.2.5 Record CRT indications

- a. CG 2279 ROLL ATT ERROR - CDU DAC OUT +5.00±0.50 VERMS
- b. CG 2219 PITCH ATT ERROR - CDU DAC OUT -5.00±0.50 VERMS
- c. CG 2249 YAW ATT ERROR - CDU DAC OUT +5.00±0.50 VERMS

6.2.20.2.6 Insert in K148

- a. VERB 33, ENTER

6.2.20.2.7 Observe on CRT

- a. V 06 NO1 Flashing
- b. R1 +00384
- c. R2 -00384
- d. R3 +00384

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6.2.20.2.8 Record CRT indications

- | | | | |
|------------|-------------------------------|-----------------|------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | +5.06±0.66 VRMS | secs |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | -5.06±0.66 VRMS | secs |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | +5.06±0.66 VRMS | secs |

6.2.20.2.9 Insert in K148

- a. VERB 33, ENTER

6.2.20.2.10 Observe on CRT

- | | | |
|---------|-----|----------|
| a. V 06 | NO1 | Flashing |
| b. R1 | | +00160 |
| c. R2 | | -00160 |
| d. R3 | | +00160 |

6.2.20.2.11 Record CRT indications

- | | | | |
|------------|-------------------------------|-----------------|------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | +5.11±0.27 VRMS | secs |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +5.11±0.27 VRMS | secs |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | +5.11±0.27 VRMS | secs |

6.2.20.2.12 Insert in K148

- a. VERB 33, ENTER

6.2.20.2.13 Observe on CRT

- | | | |
|---------|-----|----------|
| a. V 06 | NO1 | Flashing |
| b. R1 | | +00135 |
| c. R2 | | -00135 |
| d. R3 | | +00135 |

6.2.20.2.14 Record CRT indications

- | | | | |
|------------|-------------------------------|-----------------|------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | +1.78±0.23 VRMS | secs |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | -1.78±0.23 VRMS | secs |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | +1.78±0.23 VRMS | secs |

6.2.20.2.15 Insert in K148

- a. VERB 33, ENTER

6.2.20.2.16 Observe on CRT

- | | | |
|---------|-----|----------|
| a. V 06 | NO1 | Flashing |
| b. R1 | | +00090 |
| c. R2 | | -00090 |
| d. R3 | | +00090 |

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6.2.20.2.17 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	+1.19±0.15 VERMS _{ees}
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	-1.19±0.15 VERMS _{ees}
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	+1.19±0.15 VERMS _{ees}

6.2.20.2.18 Insert in K148

a. VERB 33, ENTER

6.2.20.2.19 Observe on CRT

a. V 06	NO1	Flashing
b. R1		+00000
c. R2		+00000
d. R3		-00090

6.2.20.2.20 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	0.00±0.05 VERMS _{ees}
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	0.00±0.05 VERMS _{ees}
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-1.19±0.15 VERMS _{ees}

6.2.20.2.21 Insert in K148

a. VERB 33, ENTER

6.2.20.2.22 Observe on CRT

a. V 06	NO1	Flashing
b. R1		-00090
c. R2		+00090
d. R3		-00135

6.2.20.2.23 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-1.19±0.15 VERMS _{ees}
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+1.19±0.15 VERMS _{ees}
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-1.78±0.23 VERMS _{ees}

6.2.20.2.24 Insert in K148

a. VERB 33, ENTER

6.2.20.2.25 Observe on CRT

a. V 06	NO1	Flashing
b. R1		-00135
c. R2		+00135
d. R3		-00160

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6.2.20.2.26 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-3.28±0.23 VRMS
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+1.78±0.23 VRMS
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-2.11±0.27 VRMS

6.2.20.2.27 Insert in K148

a. VERB 33, ENTER

6.2.20.2.28 Observe on CRT

a. V 96	NO1	Flashing
b. R1		-00160
c. R2		+00160
d. R3		-00384

6.2.20.2.29 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-2.11±0.27 VRMS
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+2.11±0.27 VRMS
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-2.06±0.26 VRMS

6.2.20.2.30 Insert in K148

a. VERB 33, ENTER

6.2.20.2.31 Observe on CRT

a. V 06	NO1	Flashing
b. R1		-00384
c. R2		+00384
d. R3		-00385

6.2.20.2.32 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-2.06±0.26 VRMS
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+2.06±0.26 VRMS
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-2.06±0.26 VRMS

6.2.20.2.33 Insert in K148

a. VERB 33, ENTER

6.2.20.2.34 Observe on CRT

a. V 06	NO1	Flashing
b. R1		-00385
c. R2		+00385
d. R3		+00000

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6.2.20.2.35 Record CRT indications

- | | | |
|------------|-------------------------------|-----------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | -5.08±0.66 VRMS |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +5.08±0.66 VRMS |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | 0.00±0.06 VRMS |

6.2.20.2.36 Insert in K148

- | | | |
|----------|-----|-------|
| a. V 21 | NO1 | ENTER |
| b. 02545 | | ENTER |
| c. 02637 | | ENTER |
| d. V 33 | | ENTER |

6.2.20.2.37 Observe on CRT

- | | | |
|-----------|-----|----------------------|
| a. V 99 | NO2 | Flashing |
| b. NO ATT | | ON |
| c. R1 | | +00000 approximately |
| d. R2 | | +00000 approximately |
| e. R3 | | +00000 approximately |

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6.2.20.3 TVC Test

6.2.20.3.1 The G/N Autopilot Control and SPS Ready discretes shall be applied to the G/N interface.

6.2.20.3.2 Set the OPTICS MODE selector on the Indicator Control panel to MAN. Set the OPTICS ZERO switch to OFF.

6.2.20.3.3 Insert in K148

a. VERB 33, ENTER

6.2.20.3.4 Observe on CRT

a. V 01	N 10	Flashing
b. R1		X7373
c. R3		00030

6.2.20.3.5 Insert in K148

a. V 33 ENTER

6.2.20.3.6 Observe on CRT

a. V 01	NOUN 10	Flashing
b. R1		37777
c. R3		00031

6.2.20.3.7 Insert in K148

a. V 33 ENTER

6.2.20.3.8 Observe on CRT

a. V 06	N 02	Flashing
b. R1		+00385
c. R2		-00385
d. R3		+00003

6.2.20.3.9 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+16.00+10.12±1.00 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	-16.00-10.12±1.00 VRMS

6.2.20.3.10 Insert in K148

a. VERB 33, ENTER

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6.2.20.3.11 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00384
c. R2		-00384
d. R3		+00003
e. NO ATT		OFF

6.2.20.3.12 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+10.12±1.00 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	-10.12±1.00 VRMS

6.2.20.3.13 Insert in K148

a. VERB 33, ENTER

6.2.20.3.14 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00160
c. R2		-00160
d. R3		+00003

6.2.20.3.15 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+4.22±0.42 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	-4.22±0.42 VRMS

6.2.20.3.16 Insert in K148

a. VERB 33, ENTER

6.2.20.3.17 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00135
c. R2		-00135
d. R3		+00003

6.2.20.3.18 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+3.56±0.36 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	-3.56±0.36 VRMS

6.2.20.3.19 Insert in K148

a. VERB 33, ENTER

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a. V 06	N 02	Flashing
b. R1		+00090
c. R2		-00090
d. R3		+00003

a. CG 3722 TRUNNION CDU DAC OUTPUT $+2.38 \pm 0.24$ VRMS
b. CG 3721 SHAFT CDU DAC OUTPUT -2.38 ± 0.24 VRMS

a. VERB 33, ENTER

a. V 98	N 02	Flashing
b. R1		+00000
c. R2		+00000
d. R3		+00003

a.	CG 3722	TRUNNION CDU DAC OUTPUT	0.00±0.12 VRMS
b.	CG 3721	SHAFT CDU DAC OUTPUT	0.00±0.12 VRMS

2. VERB 33. ENTER

a. V 06	N 02	Flashing
b. R1		-00090
c. R2		+00090
d. R3		+00003

a. CG 3722 TRUNNION CDU DAC OUTPUT -2.38 ± 0.24 VRMS
b. CG 3721 SHAFT CDU DAC OUTPUT $+2.88 \pm 0.24$ VRMS

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6.2.20.3.29 Set the OPTICS ZERO switch on the Indicator Control Panel to ZERO for 30 seconds, then return to OFF.

6.2.20.3.30 Insert in K148

a. VERB 33, ENTER

6.2.20.3.31 Observe on CRT

a. V 04	N 03	Flashing
b. R1		-00135
c. R2		+00135
d. R3		+00003

6.2.20.3.32 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-3.56±0.36 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	+8.56±0.36 VRMS

6.2.20.3.33 Insert in K148

a. VERB 33, ENTER

6.2.20.3.34 Observe on CRT

a. V 04	N 02	Flashing
b. R1		-00160
c. R2		+00160
d. R3		+00003

6.2.20.3.35 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-4.22±0.42 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	+4.22±0.42 VRMS

6.2.20.3.36 Insert in K148

a. VERB 33, ENTER

6.2.20.3.37 Observe on CRT

a. V 04	N 02	Flashing
b. R1		-00384
c. R2		+00384
d. R3		+00003

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6.2.20.3.38 Record CRT indications

- a. CG 3722 TRUNNION CDU DAC OUTPUT -10.12±1.00 VRMS
- b. CG 3721 SHAFT CDU DAC OUTPUT +10.12±1.00 VRMS

6.2.20.3.39 Insert in K148

- a. VERB 33, ENTER

6.2.20.3.40 Observe on CRT

- a. V 06 N 02 Flashing
- b. R1 -00385
- c. R2 +00385
- d. R3 +00003

6.2.20.3.41 Record CRT indications

- a. CG 3722 TRUNNION CDU DAC OUTPUT -10.12±1.00 VRMS
- b. CG 3721 SHAFT CDU DAC OUTPUT +10.12±1.00 VRMS

6.2.20.3.42 Insert in K148

- a. V 34 ENTER
- b. V 40 N 20 ENTER
- c. V 41 N 20 ENTER
- d. +00000 ENTER
- e. +00000 ENTER
- f. +00000 ENTER

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APPENDIX I

Signal	Link	Nomenclature	G&N Test Requirement	PSAAM and/or SCA Uncertainty % of Full Scale
CG 1020	1	+14 VDC CMC SUPPLY	+14.0 ± 0.4 VDC	0%
CG 1030	1	+4 VDC CMC SUPPLY	+4.00 ± 0.2 VDC	0%
CG 1040	2	+120 VDC PIPA SUPPLY	+120 ± 6.0 VDC	1%
CG 1051	1	+20 VDC PIPA SUPPLY	+20.0 ± 1.2 VDC	0%
CG 1052	1	-20 VDC PIPA SUPPLY	-20 ± 2 VDC	0%
CG 1070	1	+4 VDC CDU SUPPLY	+4.0 ± 0.2 VDC	0%
CG 1100	1	-28 VDC SUPPLY	-27.5 ± 6.0 VDC	0%
CG 1110	2	2.5 VDC TM BIAS	+2.50±0.05 VDC	0%
CG 1201	2	IMU 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	1%
CG 1202	1	IMU 28V .8 KC 5% - 90° RMS	28.0 ± 1.4 VRMS	0.33%
CG 1203	1	IMU 28V .8KC 0° RMS	28.0 ± 2.1 VRMS	0.33%
CG 1207	1	PH DIFF IMU 5% 0°, -90°	-90±10°	2.3%
CG 1211	1	OPTX 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	0.33%
CG 1212	1	OPTX 28V .8KC 5% -90° RMS	28.00 ±1.48 VRMS	0.33%
CG 1220	1	PH DIFF OPTX 1% IMU 1%	0° ± 10°	2.3%
CG 1331	2	3.2 KC 28V SUPPLY	28.6 ±0.56 VRMS	1%
CG 1336	1	PH DIFF 3.2 KC 28V/CMC SYNC 1	0° ± 10°	2.3%
CG 1500	1	+28 VDC IMU OPERATE BUS	28.8 ± 3VDC	0%
CG 1510	1	+28 VDC IMU STANDBY BUS	28.8 ± 3 VDC	0%
CG 1520	1	+28 VDC CMC OPERATE BUS	28.8 ± 3 VDC	0%
CG 1530	1	+28 VDC OPTX OPERATE BUS	28.8 ± 3 VDC	0%
CG 2001	2	X PIPA SG O/P	5 VRMS max	3%
CG 2021	2	Y PIPA SG O/P	5 VRMS max	0.23%
CG 2041	2	Z PIPA SG O/P	5 VRMS max	3%
CG 2108	2	IG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3.6%
CG 2112	2	IG LX RESOLVER O/P SIN	18.38 ± 1.84 VRMS @ 45°	2.5%
CG 2113	2	IG LX RESOLVER O/P COS	18.38±1.84 VRMS @ 45°	2.5%
CG 2117	2	IG SERVO ERROR IN PHASE	0.0 ± 60mv RMS @ null	1.4%
CG 2120	1	IG TORQUE MOTOR CURRENT	0.125 amp max during Fine Alignment Torquing	0%
CG 2138	1	MG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3.6%
CG 2142	2	MG LX RESOLVER O/P SIN	18.38±1.84 VRMS @45°	2.5%
CG 2143	2	MG LX RESOLVER O/P COS	18.38±1.84 VRMS @45°	2.5%
CG 2147	2	MG SERVO ERROR IN PHASE	0.0 ± 60 mv rms @ null	1.4%
CG 2150	1	MG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	0%
CG 2168	1	OG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3.6%
CG 2172	2	OG LX RESOLVER O/P SIN	18.38±1.84 VRMS @45°	2.5%
CG 2173	2	OG LX RESOLVER O/P COS	18.38±1.84 VRMS @45°	2.5%
CG 2177	2	OG SERVO ERROR IN PHASE	0.0 ± 60mvRMS @ null	1.4%
CG 2180	1	OG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	0%
CG1042	1	+120 VDC PIPA SUP NOISE RMS	1.5 VRMS MAX	0%
CG1053	1	+20 VDC PIPA SUP NOISE RMS	1.0 VRMS MAX	0%
CG1071	1	+4 VDC CDU SUP NOISE RMS	0.10 VRMS MAX	0%
CG1501	1	+28V IMU OPERATE BUS NOISE RMS	1.0 VRMS MAX	0%
CG1511	1	+28V IMU STANDBY BUS NOISE RMS	1.0 VRMS MAX	0%
CG1521	1	+28V CMC OPERATE BUS NOISE RMS	2.0 VRMS MAX	0%
CG1531	1	+28V OPTX OPERATE BUS NOISE RMS	2.0 VRMS MAX	0%

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Signal	Link	Nomenclature	G&N Test Requirement	PSAAM and/or SCA Uncertainty % of Full Scale
CG 2219	1	PITCH ATT ERROR - CDU DAC O/P	5.06 ± 0.5 VRMS @ 17°	0.67%
CG 2220	1	IG CDU FINE ERROR	0.0 ± 0.07VRMS @ null	0.29%
CG 2221	1	IG CDU COARSE ERROR	0.0 ± 0.68 VRMS @ null	0.29%
CG 2249	1	YAW ATT ERROR-CDU DAC O/P	5.06 ± 0.5VRMS @ 17°	0.67%
CG 2250	1	MG CDU FINE ERROR	0.0 ± 0.07VRMS @ null	0.29%
CG 2251	1	MG CDU COARSE ERROR	0.0 ± 0.68VRMS @ null	0.29%
CG 2279	1	ROLL ATT ERROR-CDU DAC O/P	5.06 ± 0.5VRMS @ 17°	0.67%
CG 2280	1	OG CDU FINE ERROR	0.0 ± 0.07 VRMS 2 null	0.29%
CG 2281	1	OG CDU COARSE ERROR	0.0 ± 0.68 VRMS	0.29%
CG 2300	1	PIPA TEMPERATURE	130.5±1.5°F Operate Mode	2%
CG 3011	2	TRUNNION CDU FINE ERROR	0.0 ± 0.07VRMS @ null	0.29%
CG 3021	2	SHAFT CDU FINE ERROR	0.0 ± 0.07VRMS @ null	0.29%
CG 3117	1	SXT SHAFT SERVO ERROR IN PH	2 VRMS max	1.1%
CG 3118	1	SXT TRUNNION SERVO ERROR IN PHASE	2 VRMS max	1.1%
CG 3140	1	SXT SHAFT TACH O/P	3.3 ± 1.3VRMS @ Hi Rate	1.1%
CG 3145	1	SXT SHAFT MTR CONTROL WINDING	+0.50 to +4.00 VRMS Med Rate	1.1%
CG 3150	2	SXT TRUNNION TACH O/P	3.3 ± 1.3VRMS @ Hi Rate	1.1%
CG 3155	1	SXT TRUNNION MTR CONTROL WINDING	+0.25 to +2.00 VRMS Med Rate	1.1%
CG 3160	1	SCT SHAFT TACH O/P	3.3 ± 1.3 VRMS @ Hi Rate	1.1%
CG 3170	1	SCT TRUNNION TACH O/P	0.65 ± 0.35VRMS @ Hi Rate	1.1%
CG 3721	1	SHAFT CDU DAC O/P	10.12±1.00 VRMS @ 17°	1%
CG 3722	2	TRUNNION CDU DAC O/P	10.12±1.00VRMS @ 17°	1%
CG 4300	2	CMC TEMP	87.5±42.5°F	0.23%
CG 6020	1	PIPA CAL MODULE TEMP	72.5±27.5°F	0.23%
CG 6021	1	IMU 800 cps 5% TEMP (PSA)	90±30°F	0%
CG 2301	1	IRIG TEMPERATURE	135 ± 2.5°F in Operate	2%
CG 1031	1	+14V CMC SUPPLY NOISE RMS	0.2 VRMS max	0%
CG 1031	1	+4 CMC SUPPLY NOISE RMS	0.2 VRMS max	0%

PSAAM OUTPUT is the source of Link 1 signals
SCA OUTPUT is the source of Link 2 signals.

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ADDENDUM I

SCOPE: The following changes are required to make ND1002325 applicable as G&N System technical support documentation for CSM 101.

Addition 1. Add paragraph 6.1.1.7 as follows:

6.1.1.7 Data from the on-board tape recorder shall be made available and the following signals verified:

- a. IG TORQUE MOTOR CURRENT (CG 2120) shall be less than 0.125 amp max.
- b. OG TORQUE MOTOR CURRENT (CG 2180) shall be less than 0.125 amp max.
- c. MG TORQUE MOTOR CURRENT (CG 2150) shall be less than 0.125 amp max.

Addition 2. Paragraph 6.2.1.5.6, change the last sentence to read as follows:

On the Event Recorder verify that the IMU HTR Current switch discrete (CG 2302 Link 2) is on and that the IMU Blower Current discrete (CG 2303 Link 2) is OFF over the last 2 hour period (occasionally discretizes may cycle).

Addition 3. Add paragraph 6.2.4.6.1 as follows:

6.2.4.6.1 On the analog recorder verify that (CG 1211 Link 2, OPTICS 28V 800 cps 1% 0 deg) RMS voltage is 28.0 ± 0.06 VAC.

Addition 4. Add Paragraph 6.2.20.2.5.1 and 6.2.20.2.32.1 as follows:

6.2.20.2.5.1 Verify on the analog recorder the following signals:

- a. CG 2279 Link 2 ROLL ATT ERROR - CDU DAC OUT $+5.06 \pm 0.66$ VRMS
- b. CM 2219 Link 2 PITCH ATT ERROR - CDU DAC OUT -5.06 ± 0.66 VRMS
- c. CG 2249 Link 2 YAW ATT ERROR - CDU DAC OUT $+5.06 \pm 0.66$ VRMS

6.2.20.2.32.1 Verify on the analog recorder the following signals:

- a. CG 2279 Link 2 ROLL ATT ERROR - CDU DAC OUT -5.06 ± 0.66 VRMS
- b. CG 2219 Link 2 PITCH ATT ERROR - CDU DAC OUT $+5.06 \pm 0.66$ VRMS
- c. CG 2249 Link 2 YAW ATT ERROR - CDU DAC OUT -5.06 ± 0.66 VRMS

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Addition 5. Paragraph 6.1.2.1., add new Paragraph 6.1.2.1.5 as follows:

6.1.2.1.5 Data from the on-board tape recorder shall be made available and the following signals verified.

- a. VIB NB ROLL (CG 6001)
- b. VIB NB PITCH (CG 6002)
- c. VIB NB YAW (CG 6003)

Addition 6. Replace Paragraph 6.2.3.1.13 with the following:

6.2.3.1.13 30 minutes after switching from Standby mode to the Operate mode record the IRIG temperature. The recorded IRIG temperature shall be within 0.5 deg F. of the Operate stabilized IRIG temperature determined below.

Add the following sentence to Paragraph 6.2.3.1.14:

Record the Operate mode stabilized IRIG temperature. The Operate mode stabilized IRIG temperature shall be 135±2.5° F.

Paragraph 6.2.5.2.16, add the following to Table VI:

14 CG 2301 IRIG TEMPERATURE

Addition 7. Paragraph 6.1.1.6, add item "f" as follows:

- f. The TRACKER switch on G&N Indicator Control Panel shall be set to OFF.

Addition 8. Replace Paragraph 6.2.3.1.2 with the following:

6.2.3.1.2 Switch and selectors on the G&N Indicator Control Panel shall be set as follows:

- a. OPTICS MODE to ZERO
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to MED
- d. TELESCOPE TRUNNION to SLAVE to SXT
- e. RETICLE BRIGHTNESS to minimum brightness position

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- Addition 9.** Replace Paragraph 6.2.5.1.2 with the following:
- 6.2.5.1.2** Set the following switches on the G&N Indicator Control Panel to the positions designated.
- a. OPTICS MODE to ZERO
 - b. CONTROLLER MODE to DIRECT
 - c. CONTROLLER SPEED to LO
 - d. TELESCOPE TRUNNION to SLAVE to SXT
 - e. RETICLE BRIGHTNESS to minimum brightness position
- Addition 10.** Replace Paragraph 6.2.5.2.1 with the following:
- 6.2.5.2.1** Set or verify the following G&N Indicator Control Panel switches to the position indicated.
- a. CONDITION LAMPS to ON
 - b. OPTICS MODE to ZERO
 - c. CONTROLLER COUPLING to DIRECT
 - d. CONTROLLER SPEED to LO
 - e. TELESCOPE TRUNNION to SLAVE to SXT
 - f. RETICLE BRIGHTNESS to minimum brightness position
- Addition 11.** Replace Paragraph 6.2.5.3.6 with the following:
- 6.2.5.3.6** Insure that the following switches are set to the positions indicated:
- a. CONTROLLER COUPLING to DIRECT
 - b. OPTICS MODE to ZERO
 - c. TELESCOPE TRUNNION to SLAVE to SXT
 - d. TRACKER to OFF
 - e. CONTROLLER SPEED to LO
 - f. CONDITION LAMPS to ON
 - g. UP TELEMETRY to ACCEPT
- Addition 12.** Replace Paragraph 6.2.9.23 with the following:
- 6.2.9.23** Set the OPTICS MODE switch on the Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to CMC.

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Addition 13. Replace Sections 6.2.10 through 6.2.13 with the following:

6.2.10 Zero Optics Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2 Turn On Procedure before proceeding.

INITIALIZATION

6.2.10.1 Set the G/N POWER - OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.10.2 Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.

- a. VERB 41, NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.10.3 Insure that the following switches on the G&N Indicator Control Panel are set as follows:

- a. TELESCOPE TRUNNION to SLAVE to SXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to HI

OPTICS ZERO MODE TEST

6.2.10.4 Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K-148. Press the ENTER pushbutton.

6.2.10.5 Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following on R1 and R2 of the DSKY.

- a. R1 = +0.00° +0.02° , -0.03° (Shaft Angle)
- b. R2 = +0.000° +0.006° , -0.007° (Trunnion LOS Angle)

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6.2.10.5.1 Enter the following:

VERB 01 NOUN 10, ENTER
00033, ENTER
Verify R1 = XXX6X

6.2.10.5.2 Set the OPTICS MODE switch to CMC. Enter the following:

ENTER
00033, ENTER
Verify R1 = XXX5X

6.2.10.5.3 Set the OPTICS MODE switch to MAN. Press the KEY REL pushbutton on the DSKY.

OPTICS TIME TO ZERO TEST

6.2.10.6 Set up the Analog Recorder to monitor the following measurements.

- a. CG 3140 SXT Shaft Tach Output
- b. CG 3150 SXT Trunnion Tach Output
- c. CG 3160 SCT Shaft Tach Output
- d. CG 3170 SCT Trunnion Tach Output
- e. CG 3117 SXT Shaft Servo Error in-phase
- f. CG 3118 SXT Trunnion Servo Error in-phase

6.2.10.7 Push the Optics Hand Controller to the right, driving the SXT Shaft until R1 on the DSKY indicates $+180 \pm 1$ deg. Push the Optics Hand Controller up, driving the SXT Trunnion until R2 on the DSKY indicates $+75 \pm 1$ deg.

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- 6.2.10.8 Start the Analog Recorders and set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.
- 6.2.10.9 Monitor the Analog Recorders until all signals return to null. Stop the Analog Recorders. The elapsed time between the initial and final SXT shaft and Trunnion Tach output nulls shall be less than 15 seconds. The peak magnitude of the SXT Shaft (CG 3140) and Trunnion (CG 3150) tach outputs shall be -3.3 ± 1.3 VRMS. The peak magnitude of the SCT Shaft Tach Output (CG 3160) shall be 3.3 ± 1.3 VRMS. The peak magnitude of the SCT Trunnion Tach Output (CG 3170) shall be 0.85 ± 0.35 VRMS. The SXT Shaft (CG 3117) and Trunnion (CG 3118) Servo Error in-phase measurements shall each have a maximum magnitude of 2 VRMS.
- 6.2.10.10 Record R1 and R2 on the CRT. The data displayed shall be as follows:
- R1 = $+0.00^\circ$ $+0.02^\circ$, -0.03° (Shaft Angle)
 - R2 = $+0.000^\circ$ $+0.006^\circ$, -0.007° (Trunnion LOS Angle)
- Enter VERB 34 and press the ENTER pushbutton.
- 6.2.10.11 Record the Telescope Panel Angle Counter indications. The Shaft Angle shall be 0.0 ± 0.11 degrees. The Trunnion Angle shall be 0.0 ± 0.22 degrees.
- 6.2.10.12 Set the OPTICS MODE switch on the G&N Indicator Control Panel to MAN. Set the G/N Power Optics Switch on the LEB Lighting Control Panel to OFF.
- OPTICS BACKUP MODE TEST**
- 6.2.10.13 Insert the Inflight Tool (V36601405) into the Trunnion Tool input and engage drive mechanism (button out). Verify that the trunnion turns by viewing the movement through the SCT eyepiece while turning the tool until the TPAC reads +5 deg. Remove the tool from the trunnion tool input.
- 6.2.10.14 Insert the Inflight Tool (V36601405) into the Shaft Tool input and engage the drive mechanism (button out). Verify that the Shaft turns by viewing the movement through the SCT eyepiece while turning the tool so that the shaft moves through an angle from 0° to $+3^\circ$ to -3° to 0° as indicated on the shaft TPAC. Disengage the shaft drive mechanism (button in) and remove the tool.

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6.2.10.15 Insert the Inflight Tool (V36601405) into the Trunnion Tool input. Verify that the Trunnion Turns by viewing the movement through the SCT eye-piece while turning the tool so that the trunnion moves from +5° to -5° and back to zero as indicated on the Trunnion TPAC. Disengage the trunnion drive mechanism (button in) and remove the tool.

6.2.11 Optics Coordinate Transformation Control Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure before proceeding.

INITIALIZATION

6.2.11.1 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.11.2 Enter the following into the K-Start. Press the ENTER pushbutton after each entry:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.11.3 Verify and/or set the following switches on the G&N Indicator control panel to the position indicated.

- a. TELESCOPE TRUNNION to SLAVE to SXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to HI

6.2.11.4 Set up the analog recorders to monitor the following measurements.

- a. CG 3170 SCT Trunnion Tachometer Output

6.2.11.5 Enter the following into the K-Start to monitor the OPTICS CDU's.

VERB 16 NOUN 55, press ENTER

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- 6.2.11.6 Set the OPTICS MODE switch on the G&N Panel to ZERO. Wait 15 seconds. Return the OPTICS MODE switch to MAN

RESOLVED MODE PHASING AND IMAGE RATE TEST

- 6.2.11.7 Using the Optics Control Stick, drive the Optics until $R1 = +225.00$ and $R2 = +10.000$ on the CRT and the DSKY's.
- 6.2.11.8 Set the CONTROLLER COUPLING switch on the G&N Panel to RSLV and CONTROLLER SPEED switch to MED.
- 6.2.11.9 Position the movable optics target such that it is centered on the SCT reticle pattern, then start the analog recorders at a chart speed of 10 mm/second.
- 6.2.11.10 Quickly displace the Optics Control Stick 45 ± 10 degrees in the upper right hand quadrant while sighting on the optics target through the SCT eyepiece. The target shall appear to move in the upper right field of view of the SCT at 45 ± 10 deg. When target leaves the SCT upper right field of view press MARK pushbutton and immediately record the shaft angle as displayed on R1 of the DSKY. The recorded shaft angle shall be $+225 \pm 10.00$ degrees.
- 6.2.11.11 Stop the analog recorder and measure the elapsed time between the initial and the final signal null conditions for the Trunnion measurement. The elapsed time shall be $+19$ to $+32$ seconds.

CSM AMPLIFIER SHAFT AND TRUNNION DRIVE TEST

- 6.2.11.12 Set the CONTROLLER COUPLING switch to DIRECT. Again using the Optics Control Stick, drive the optics until $R1 = +225.00$ and $R2 = +10.000$. Set the CONTROLLER COUPLING switch to RSLV.
- 6.2.11.13 While sighting on the optical target through the SCT eyepiece, displace the Optics Control Stick fully to the right. Verify that the target image appears to move in a straight line horizontally to the right and release the Optics Control Stick when the target image reaches the edge of the SCT field of view.
- 6.2.11.14 Enter VERB 34 in the DSKY. Press the ENTER pushbutton.

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6.2.11.15 Set the CONTROLLER COUPLING switch on the G&N Panel to DIRECT. Set the OPTICS MODE switch to ZERO. After 15 seconds, return the switch to MAN.

NOTE: If optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.12 Optics Functional Test

Proceed with this test if 6.2.3 Operate Power On Test, or 6.2.5.2 Turn-on Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding.

NOTE: This test requires the use of the G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT StLOS before proceeding. Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.

6.2.12.1 Set/verify the G/N POWER OPTICS switch on the LEB Lighting Control Panel to OPTICS. Set TRACKER switch to OFF. Verify the following:

- a. +28 VDC OPTX OPERATE BUS (CG 1530) is 28.8±3 VDC. Record the indication on the CRT.
- b. CG 1211 OPTX 28V 800 cps 1% 0 ph not flashing on CRT.
- c. CG 1212 OPTX 800 cps 5% -90 ph not flashing on CRT.

6.2.12.2 Enter the following sequence into the K-Start.

- a. VERB 41, NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

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- 6.2.12.3 Insure that the optics control switches on the G&N Indicator Control Panel are set as follows:
- a. OPTICS MODE to MAN
 - b. CONTROLLER SPEED to LO
 - c. CONTROLLER COUPLING to DIRECT
 - d. TELESCOPE TRUNNION to SLAVE to SXT
- 6.2.12.4 Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN.
- 6.2.12.5 Resolution Checks
- 6.2.12.5.1 Sight through the SXT eyepiece. Using the Optic Control Stick, adjust the SXT to obtain the best reflected field of view of the 5-inch autocollimator reticle engraving at the center of the field of view.
- 6.2.12.5.2 Note that the autocollimator reticle contains a series of lines of different thickness and width. Each set of lines is marked with a number (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines. The SXT resolution shall be at least 10 arc-seconds at the center of the field of view.
- 6.2.12.5.3 Repeat 6.2.12.5.1 and 6.2.12.5.2 using the SCT and the SCT resolution chart. The SCT shall have a resolution of at least 3 arc-minutes at the center of the field of view.
- 6.2.12.6 Slave Telescope Mode Checks
- 6.2.12.6.1 Enter VERB 16 NOUN 55 into the K-Start, press the ENTER pushbutton.
- 6.2.12.6.2 Set the OPTICS MODE switch on the Control Indicator Panel to ZERO. Wait 15 seconds.
- 6.2.12.6.3 Record the SCT Shaft and Trunnion angles as indicated by the TPAC and the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between the TPAC Shaft angle and the Shaft CDU angle shall be ± 0.11 deg or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be ± 0.22 deg or less.

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- 6.2.12.6.4 Place the OPTICS MODE switch to MAN. Using the Optics Control Stick drive the SXT Shaft and Trunnion CDU's until $R1 = 035.00 \pm 0.10$ deg and $R2 = +35.00 \pm 0.100$ deg, setting the CONTROLLER SPEED switch to LO as the angles are approached. Press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles as indicated by the TPAC. Record $R1$ and $R2$. The difference between the TPAC Shaft angle and Shaft CDU angle shall be ± 0.11 deg or less. The difference between the TPAC Trunnion angle and Trunnion CDU angle shall be ± 0.22 deg or less.
- 6.2.12.6.5 Set the OPTICS MODE switch to ZERO.
- 6.2.12.6.6 Set the TELESCOPE TRUNNION switch to SLAVE to SXT position.
- 6.2.12.6.7 Remove the plug from the base of the SXT eyepiece and install the Adapter Assembly and Portable Light Assembly. Turn on the light.
- NOTE: If needed to reduce external light, place a photographers hood over the optics head and retroreflecting prism.
- 6.2.12.6.8 Sight through the SCT eyepiece and provide direction to personnel outside spacecraft for positioning the Retroreflecting Prism, Model No. A23-200, to span between the SXT LLOS and SCT LOS such that the illumination from the back-light filament is clearly visible at the center of the field of view. Prism must be held in this alignment position until completion of step 6.2.12.6.11.
- 6.2.12.6.9 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Note the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement, expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. For instance, the outer ends of the SXT reticle lines are 6% from center. Displacement shall be less than 50% (bar must be closer to center than to edge of field of view).
- 6.2.12.6.10 Set the TELESCOPE TRUNNION switch to 0° position.
- 6.2.12.6.11 Again direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in Step 6.2.12.6.9. Place the OPTICS MODE switch to MAN and observe the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement, expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. Displacement shall be less than 50%.
- 6.2.12.6.12 Remove the Retroreflecting Prism.

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- 6.2.12.6.13 Replace the Portable Light in the adapter on the SXT eyepiece.
- 6.2.12.6.14 While sighting into the SCT eyepiece, set the TELESCOPE TRUNNION switch to 25° and observe that the resolution pattern mounted outside the spacecraft appears to move downward from the center of the field of view to the zero reticle marking that is 25° below the center of the field of view.
- 6.2.12.6.15 Record the TPAC Trunnion Angle. It shall be 25.00±0.22 deg.
- 6.2.12.6.16 Set the TELESCOPE TRUNNION switch to SLAVE to SXT.
- 6.2.12.7 SXT Parallelism Tests
- 6.2.12.7.1 Using the Optics Control Stick drive the SXT StLOS Trunnion to +15.000° ±2° as indicated in R2 of the DSKY. Maintain a Shaft CDU angle of 000.00 ±0.10 degrees as indicated by R1 of the DSKY.
- 6.2.12.7.2 Sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to superimpose the SXT LLOS horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.
- 6.2.12.7.3 Repeat 6.2.12.7.2 twice. Calculate and record the average of the three autocollimator readings.
- 6.2.12.7.4 Set the OPTICS MODE switch to ZERO.
- 6.2.12.7.5 Again sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to bring the SXT StLOS horizontal reticle and autocollimator horizontal filar images to coincide. Record the autocollimator reading.
- 6.2.12.7.6 Repeat 6.2.12.7.5 twice. Calculate and record the average of the three autocollimator readings. The average value obtained here shall not differ from that obtained in 6.2.12.7.3 by more than 10 arc-seconds.
- 6.2.12.7.7 Set the OPTICS MODE switch to MAN. Using the Optics Control Stick drive the SXT Trunnion angle to 85.00±5 degrees as indicated on R2 of the DSKY. Set the CONTROLLER SPEED switch to LO and drive the SXT Trunnion to +90.000 degrees ±0.100 degree as indicated on R2 of the DSKY. Insure that the SXT Shaft angle remains at 000.00±0.10 degree as indicated by R1 on the DSKY.
- 6.2.12.7.8 Sight through the SXT. Two reticle patterns shall be visible. Use the Optics Control Stick to adjust the SXT Trunnion angle until the two horizontal reticle lines are coincident. Record the Trunnion CDU angle displayed in R2. The Trunnion CDU angle shall be 90.000±0.010 degrees.

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- 6.2.12.7.9 Remove the Portable Light Assembly and Adapter Assembly from the base of the SXT eyepiece. Replace the SXT eyepiece plug.
- NOTE: If optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.
- 6.2.12.8 Shaft and Trunnion Positional Accuracy Checks
- 6.2.12.8.1 Set the OPTICS MODE switch to ZERO. After 15 seconds, return the selector to MANUAL.
- 6.2.12.8.2 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.3 Sight through the SXT. Using the control stick align the SXT SLOS with optical Target No. 1 on the G&N Installation Fixture Model A23-097. Set the CONTROLLER SPEED switch to LO as the target is approached. When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.
- 6.2.12.8.4 Sight through the SXT. Using the control stick align the SXT SLOS with Optical Target No. 2 on A23-097. Set the CONTROLLER SPEED switch to LO as the target is approached.
- 6.2.12.8.5 When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.
- 6.2.12.8.6 Set the OPTICS MODE switch to ZERO. After 15 seconds set the switch to CMC.
- 6.2.12.8.7 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.8 Enter the value recorded from R1 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.9 Enter the value recorded from R2 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.10 Sight through the SXT. The SLOS should be centered on Optical Target No. 1 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.3 shall be less than 0.25 degrees. Record the difference.

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- 6.2.12.8.11 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.12 Enter the value recorded from R1 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.13 Enter the value recorded from R2 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.14 Sight through the SXT. The SLOS should be centered on Optical Target No. 2 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.5 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.15 Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MANUAL.
- 6.2.12.8.16 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start 3 times. Press the ENTER pushbutton after each entry.
- 6.2.13 Optics Slew Rate Test
- NOTE: Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.13.1 Set/verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CB 1530) is +28.0±3.0 VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT. Set TRACKER switch to OFF.
- 6.2.13.2 Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.
- a. VERB 41 NOUN 20, ENTER
 - b. +00000, ENTER
 - c. +00000, ENTER
 - d. +00000, ENTER
- 6.2.13.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the positions indicated.
- a. TELESCOPE TRUNNION to SLAVE to SXT
 - b. CONTROLLER COUPLING to DIRECT
 - c. CONTROLLER SPEED to HI

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- 6.2.13.4 Monitor MARK Command by entering VERB 06 NOUN 56 into K-148. Press the ENTER pushbutton.

TRUNNION SLEW RATE - HI SPEED

- 6.2.13.5 Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS MODE switch on the G&N Indicator Panel to MAN.

- 6.2.13.5.1 During the Trunnion Slew Rate Test HI Speed, monitor and verify the following signals on the CRT.

- a. SXT TRUNNION TACH O/P (CG 3150 LINK 2) shall be 3.3±1.3 VRMS
b. SCT TRUNNION TACH O/P (CG 3170 LINK 2) shall be -0.85±0.35 VRMS

NOTE: Read and understand step 6.2.13.6 before proceeding. Do not hold Control Stick at upper limit more than 10 seconds, or exceed a trunnion angle of 85 degrees.

- 6.2.13.6 Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R2 = ±XX.XXX (Trunnion LOS angle in deg)
b. R3 = +XXX.XX (Time in seconds)

After the display has changed, again record the values of R2 and R3.

- 6.2.13.7 Perform the following calculations:

NOTE: In performing calculation b. below, and in similar calculations throughout this test procedure, the following shall be noted and taken into account. It is possible that the second R3 reading may be smaller than the first reading. If so, add an overflow time value of 163.84 sec to the second reading and then subtract the first reading, in order to obtain Δ time as the difference of the two R3 readings.

- a. Difference between R2 displays = _____ (Δ trunnion angle)
b. Difference between R3 displays = _____ (Δ time)
c. $\frac{\Delta \text{trunnion angle}}{\Delta \text{time}} = \text{ } \text{deg/sec}$

The Trunnion Slew Rate shall be 10±2 deg/sec.

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SHAFT SLEW RATE - HI SPEED

6.2.13.8 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

6.2.13.8.1 During the Shaft Slew Rate Test - Hi Speed, monitor and verify the following signals on the CRT.

- a. SXT SHAFT TACH O/P (CG 3140 Link 2) shall be 3.3 ± 1.3 VRMS
- b. SCT SHAFT TACH O/P (CG 3160 Link 2) shall be 3.3 ± 1.3 VRMS

NOTE: Read and understand step 6.2.13.9 before proceeding. Do not hold Control Stick at right limit for more than 10 seconds, or exceed a shaft angle of 250 degrees.

6.2.13.9 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R1 = $\pm XXX.XX$ (shaft angles in deg)
- b. R3 = $\pm XXX.XX$ (time in seconds)

After the display has changed, again record the values of R1 and R3.

6.2.13.10 Perform the following calculations:

- a. Difference between R1 displays = $\text{---} \cdot \text{---}$ (Δ shaft angle)
- b. Difference between R3 displays = $\text{---} \cdot \text{---}$ (Δ time)
- c. $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{---} \cdot \text{---}$ deg/sec

The Shaft Slew Rate shall be 19.5 ± 3.9 deg/sec.

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TRUNNION SLEW RATE - MED SPEED

- 6.2.13.11 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to MED. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.12 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

- 6.2.13.12 Record the SXT TRUN MTR control winding (CG 3155) signal on the CRT while slewing the optics. The voltage shall be +0.25 to +2.00 VRMS. Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- R2 = ±XX.XXX (trunnion LOS angle in deg)
- R3 = +XXX.XX (time in seconds)

After the display has changed, again record the values of R2 and R3.

- 6.2.13.13 Perform the following calculations:

- Difference between R2 displays = (Δtrunnion angle)
- Difference between R3 displays = (Δtime)
- $\frac{\Delta \text{trunnion angle}}{\Delta \text{time}} = \text{. deg/sec}$

The Trunnion Slew Rate shall be 1.0±0.2 deg/sec.

SHAFT SLEW RATE - MED SPEED

- 6.2.13.14 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.15 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

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6.2.13.15 Record the SXT SHAFT MTR control winding (CG 3145) signal on the CRT while slewing the optics. The voltage shall be +0.50 to +4.00 VRMS. Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R1 = ±XXX.XX (shaft angle in deg)
- b. R3 = +XXX.XX (time in seconds)

After display has changed, again record the values of R1 and R3.

6.2.13.16 Perform the following calculations:

- a. Difference between R1 displays = ____ . ____ (Δ shaft angle)
- b. Difference between R3 displays = ____ . ____ (Δ time)
- c. $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = _ . _ \text{ deg/sec}$

The Shaft Slew Rate shall be $2.0 \pm 0.4 \text{ deg/sec}$.

TRUNNION SLEW RATE - LO SPEED

6.2.13.17 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to LO. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

6.2.13.17.1 During the Trunnion Slew Rate Test-Lo Speed, monitor and verify the following signal on the CRT.

- a. TRUNNION CDU FINE ERROR (CG 3011 Link 2) ±.07 VRMS MAX

NOTE: Read and understand 6.2.13.18 before proceeding. Do not hold control stick at upper limit for more than 30 seconds.

6.2.13.18 Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

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- a. R2 = ±XX.XXX (trunnion LOS angle in deg)
- b. R3 = +XXX.XX (time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.19 Perform the following calculations:

- a. Difference between R2 displays = XX.XXX (Δ trunnion angle)
- b. Difference between R3 displays = XXX.XX (Δ time)

c. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}} = \text{--- deg/sec}$

The Trunnion Slew Rate shall be 0.10±0.02 deg/sec

SHAFT SLEW RATE - LO SPEED

6.2.13.20 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

6.2.13.20.1 During the Shaft Slew Rate Test -LO Speed, monitor and verify the following signal on the CRT.

a.- SHAFT CDU FINE ERROR (CG 3021 Line 2) ±.07 VRMS MAX

NOTE: Read and understand 6.2.13.21 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.21 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later, press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R1 = ±XXX.XX (shaft angles in deg)
- b. R3 = +XXX.XX (time in seconds)

After the display has changed, again record the values of R1 and R3.

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6.2.13.22 Perform the following calculations:

- Difference between R1 displays = _____ (Δ shaft angle)
- Difference between R3 displays = _____ (Δ time)
- $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \text{--- deg/sec}$

The Shaft Slew Rate shall be 0.20±0.04 deg/sec

OPTICS HAND CONTROLLER DRIFT RATE CHECK-LO SPEED

6.2.13.23 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

6.2.13.24 Press the MARK pushbutton and record the display in R1, R2, and R3. Approximately 60 seconds after the first MARK, again press the first MARK pushbutton and record the new data displayed in R1, R2 and R3. The data displayed is in the following form:

- R1 = aXXX.XX (shaft angle in deg)
- R2 = aXX.XXX (trunnion LOS angle in deg)
- R3 = +XXX.XX (time in seconds)

6.2.13.25 Perform the following calculations:

- Difference between R1 displays = _____ (Δ shaft angle)
- Difference between R2 displays = _____ (Δ trunnion angle)
- Difference between R3 displays = _____ (Δ time)
- $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \text{--- deg/sec (Shaft Drift Rate)}$

Shall be less than 0.0333 deg/sec.

- $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}} = \text{--- deg/sec (Trunnion Drift Rate)}$

Shall be less than 0.0167 deg/sec.

6.2.13.26 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

Addition 14. Replace Paragraph 6.2.17.5 and 6.2.17.20 with the following:

6.2.17.5 On the G&N Indicator Control Panel, set the following switches to the position indicated.

- TELESCOPE TRUNNION to SLAVE to SXT
- CONTROLLER COUPLING to DIRECT
- CONTROLLER SPEED to LO
- OPTICS MODE to MAN

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6.2.17.20 Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN. Enter VERB 33, ENTER into the DSKY.

Addition 15. Replace Paragraphs 6.2.18.10.1, 6.2.18.10.2, 6.2.18.19, 6.2.18.20, and 6.2.18.22 with the following:

6.2.18.10.1 Between 235 minutes and 240 minutes from T_0 set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.

6.2.18.10.2 Enter the following into the DSKY:

- a. VERB 21 NOUN 03 ENTER
- b. 02663 ENTER
- c. +XXX.XX±000.01 ENTER (Target No. 1 Az)
- d. Press ENTER pushbutton
- e. 02664 ENTER
- f. +XXX.XX ±000.01 ENTER (Target No. 2 Az)
- g. Press ENTER pushbutton
- h. 02665 ENTER
- i. +00.000 ENTER (Target No. 1 EL)
- j. Press ENTER pushbutton
- k. 02666 ENTER
- l. +00.000 ENTER (Target No. 2 EL)

On the G&N Indicator Control Panel, set the OPTICS MODE switch to MAN and the CONTROLLER SPEED switch to HI. Drive the StLOS to the approximate position of Target No. 1. Set the CONTROLLER SPEED switch to LO.

NOTE: Read the following 10 steps before proceeding. These are time critical steps and must be performed as rapidly as possible.

6.2.18.19 Set the CONTROLLER SPEED switch to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target 2.

6.2.18.20 Set the CONTROLLER SPEED switch to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 2 and press the MARK pushbutton. If satisfied that the MARK was good, press the ENTER pushbutton. If not satisfied, press the MARK REJECT pushbutton and repeat this step.

6.2.18.22 Enter VERB 34 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT and DSKY's indicate 02. Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.

Addition 16. Replace Paragraph 6.2.20.3.2, 6.2.20.3.22, and 6.2.20.3.29 with the following:

6.2.20.3.2 Set the OPTICS MODE selector on the Indicator Control Panel to MAN.

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- 6.2.20.3.22 Set the OPTICS CONTROLLER SPEED switch on the Indicator Control Panel to HI.
- 6.2.20.3.29 Set the OPTICS MODE switch on the Indicator Control Panel to ZERO for 30 seconds, then return to MAN.

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ADDENDUM II

SCOPE: The following changes are required to make ND1002325 applicable as G&N System technical support documentation for systems containing SUNDIAL C test ropes. Refer to Drawing 2014999 to define further which test ropes and jumper modules shall be installed.

Change 1: Paragraphs 6.2.9.1.4, 6.2.9.2a, 6.2.9.3a, 6.2.9.5a, 6.2.9.6a, 6.2.9.7a, 6.2.9.8, 6.2.9.10a, 6.2.9.11a, 6.2.9.13a, 6.2.9.15a, 6.2.9.16a, 6.2.9.23. In each of these paragraphs change "VERB 06 NOUN XX flashing" to "VERB 33 NOUN XX flashing."

Change 2: Paragraphs 6.2.20.2.2a, 6.2.20.2.4a, 6.2.20.2.7a, 6.2.20.2.10a, 6.2.20.2.13a, 6.2.20.2.16a, 6.2.20.2.19a, 6.2.20.2.22a, 6.2.20.2.25a, 6.2.20.2.28a, 6.2.20.2.31a, 6.2.20.2.34a, 6.2.20.2.37a, 6.2.20.3.8a, 6.2.20.3.11a, 6.2.20.3.14a, 6.2.20.3.17a, 6.2.20.3.20a, 6.2.20.3.24a, 6.2.20.3.27a, 6.2.20.3.31a, 6.2.20.3.34a, 6.2.20.3.37a, 6.2.20.3.40a; in each of these steps, change "V06" to "V33".

Change 3: Paragraph 6.2.16.7.19 Change FROM: On K-148 enter the following sequence:

VERB 21	NOUN 01	ENTR
00407		ENTR
77757		ENTR
VERB 21	NOUN 01	ENTR
00411		ENTR
00020		ENTR
VERB 33		ENTR

Change TO: On K-148 enter the following sequence:

VERB 21	NOUN 01	ENTR
02502		ENTR
77757		ENTR
VERB 21	NOUN 01	ENTR
02504		ENTR
00020		ENTR
VERB 33		ENTR

Change 4: Paragraph 6.2.16.7.33 Change FROM: On K-148 enter the following sequence:

VERB 21	NOUN 01	ENTR
00405		ENTR
00020		ENTR
VERB 21	NOUN 01	ENTR
00407		ENTR
77757		ENTR
VERB 33		ENTR

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ADDENDUM II

Change 4
(Continued)

Change TO: On K-148 enter the following sequence:

VERB 21	NOUN 01	ENTR
02500		ENTR
00020		ENTR
VERB 21	NOUN 01	ENTR
02502		ENTR
77757		ENTR
VERB 33		ENTR

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ADDENDUM III

SCOPE. The following changes are required to make ND1002325 applicable on G&N System technical support documentation for CSM 2TV-1.

Change 1: Make the changes as specified in Additions 11 through 20 of Addendum I.
Delete the following paragraphs from Addition 17: 6.2.13.5.1, 6.2.13.8.1,
6.2.13.17.1, 6.2.13.20.1.

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POST INSTALLATION CHECKOUT PROCESS
 SPECIFICATION FOR THE APOLLO GUIDANCE
 AND NAVIGATION SYSTEM - BLOCK II

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
12/21/67	G	35343	26, 33, 48, 50, 54	EA <i>SHC</i>	—
2/28/68	H	35700	3, 4, 8, 11-13, 17, 21, 23, 25-27, 30-33, 38, 40-42, 47-51, 54, 61	EA	WLS
			62, 69-134: was 134 pages.		
			now 158 pages. <i>EA/AC</i>		
4/4/68	J	36039	6, 69-71, 73-84, 106, 113, 115, 130, 135-158; was 158 pages, now 157 pages; total no. pages 158.	EA	RJJ
			<i>RNR/AC</i>		

This specification consists of pages 1 to 157 including Appendix I, pages 132-133, Addendum I, pages 134-154, Addendum II, pages 155-156 and Addendum III, page 157.

APPROVALS	Not required per CSA-497-0274		R. D. Petryk	D. A. Ziemer
	NASA/MSC	MIT/IL	AC	

- 6.2.9.22 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 20 seconds VERB 06 NOUN 55 shall flash on the CRT. The ISS WARNING lamp on the Control Indicator Panel shall extinguish. The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be OFF.
- 6.2.9.23 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Set the OPTICS MODE switch to CMC.
- 6.2.9.24 Enter VERB 33 into K-148 and press the ENTER pushbutton. After approximately 25 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 66 flashing
 - b. R1 = 000xx
 - c. R2 = xxxxx
- Record R1 and R2 as the Shaft Optics CDU drive rate.
Shaft rate = $\frac{R1}{R2}$. The Shaft Optics CDU drive rate shall be $7.32 \pm 1.83^\circ / \text{sec}$.
- 6.2.9.25 Enter VERB 33 into K148. Press the ENTER pushbutton. In about 15 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 66
 - b. R1 = 0000x
 - c. R2 = xxxxx
- Record R1 and R2 as the Trunnion Optics CDU drive rate. Trunnion rate = $\frac{R1}{R2}$. The Trunnion Optics CDU drive rate shall be $1.83 \pm 0.45^\circ / \text{sec}$.
- 6.2.9.26 Terminate the Semi-Automatic Moding Check by entering VERB 34 into K148. Observe PROG display on DSKY's is 00. Press the ENTER pushbutton. Set the G&N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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6.2.10 Zero Optics Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 Turn On procedure before proceeding.

INITIALIZATION

6.2.10.1 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $+28.0 \pm 3.0$ VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.10.2 Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.

- VERB 41 NOUN 20 ENTER
- +00000, ENTER
- +00000, ENTER
- +00000, ENTER

6.2.10.3 Insure that the following switches on the G&N Indicator Control Panel are set as follows:

- OPTICS TEL TRUN to SLAVE TO SXT
- OPTICS COUPLING to DIRECT
- OPTICS SPEED to HI
- OPTICS MODE to MAN

OPTICS ZERO MODE TEST

6.2.10.4 Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K-148. Press the ENTER pushbutton.

6.2.10.5 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following on R1 and R2 of the DSKY.

- $R1 = +0.00^\circ \pm 0.02^\circ, -0.03^\circ$ (Shaft Angle)
- $R2 = +0.000^\circ \pm 0.006^\circ, -0.007^\circ$ (Trunnion Los Angle)

Record the TPAC indications. The Shaft Angle shall be 0.0 ± 0.11 degrees. The Trunnion Angle shall be 0.0 ± 0.22 degrees.

6.2.10.5.1 Enter the following:

VERB 01 NOUN 10, ENTER
00033, ENTER
Verify R1 = XXX6X

6.2.10.5.2 Return the OPTICS ZERO switch to OFF. Set the OPTICS MODE switch to CMC. Enter the following:

ENTER
00033, ENTER
Verify R1 = XXX5X

6.2.10.5.3 Set the OPTICS MODE switch to MAN. Press the KEY REL pushbutton on the DSKY.

OPTICS TIME TO ZERO TEST

6.2.10.6 Deleted.

6.2.10.7 Deleted.

6.2.10.8 Deleted.

6.2.10.9 Deleted.

6.2.10.10 Deleted.

6.2.10.11 Deleted.

- c. OPTICS SPEED to HI
- d. OPTICS MODE to MAN

6.2.11.4 Set up the analog recorders to monitor the following measurements:

- a. CG 3170 SCT Trunnion Tachometer Output

6.2.11.5 Enter the following into the K-Start to monitor the OPTICS CDU's.

VERB 16 NOUN 55, press ENTER

6.2.11.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the G&N Panel to ZERO. Wait 15 seconds. Return the OPTICS ZERO switch to OFF.

RESOLVED MODE PHASING AND IMAGE RATE TEST

6.2.11.7 Using the OPTICS CONTROL STICK, drive the Optics until R1 = +225.00 and R2 = +10.000 on the CRT and the DSKY's.

6.2.11.8 Set the OPTICS COUPLING switch on the G&N Panel to RSLV and controller speed switch to MED.

6.2.11.9 Position the movable optics target such that it is centered on the SCT retical pattern, then start the analog recorders.

6.2.11.10 Quickly displace the OPTICS CONTROL STICK 45 ± 10 degrees in the upper right hand quadrant while sighting on the optics target through the SCT eyepiece. The target shall appear to move in the upper right field of view of the SCT at 45 ± 10 deg. When target leaves the SCT upper right field of view press MARK pushbutton and immediately record the shaft angle as displayed on R1 of the DSKY. The recorded shaft angle shall be $+225 \pm 10.00$ degrees.

6.2.11.11 Stop the analog recorder and measure the elapsed time between the initial and the final signal null conditions for the trunnion measurement. The elapsed time shall be +19 to +32 seconds.

CSC AMPLIFIER SHAFT AND TRUNNION DRIVE TEST

6.2.11.12 Set the OPTICS COUPLING switch to DIRECT. Again using the OPTICS CONTROL STICK, drive the optics until R1 = +225.00 and R2 = +10.000. Set the OPTICS COUPLING switch to RSLV.

6.2.11.13 While sighting on the optical target through the SCT eyepiece displace the OPTICS CONTROL STICK fully to the right. Verify that the target image appears to move in a straight line horizontally to the right and release the OPTICS CONTROL STICK when the target image reaches the edge of the SCT field of view.

6.2.11.14 Enter VERB 34 in the DSKY.
Press the ENTER pushbutton.

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6.2.11.15

Set the OPTICS COUPLING switch on the G&N Panel to DIRECT. Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion Slaved to SXT). Set the OPTICS ZERO switch to ZERO.

NOTE: If Optics testing will continue, set the G/N POWER OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.12

Optics Functional Test

Proceed with this test if 6.2.3 Operate Power On Test, or 6.2.5.2, Turn-On Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2, Turn On Procedure, before proceeding.

NOTE: This test requires the use of the G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT SLOS before proceeding. Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.

6.2.12.1

Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Set Tracker switch to OFF. Verify the following:

- a. +28 VDC OPTX OPERATE BUS (CG 1530) is 28.8±3 VDC. Record the indication on the CRT.
- b. CG 1211 OPTX 28V 800 cps 1% 0 ph not flashing on CRT.
- c. CG 1212 OPTX 800 cps 5% - 90 ph not flashing on CRT.

6.2.12.2

Enter the following sequence into the K-Start.

- a. VERB 41, NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.12.3

Insure that Optics Control switches on the G&N Indicator Control Panel are set as follows:

- a. OPTICS ZERO to OFF
- b. OPTICS MODE to MAN
- c. OPTICS SPEED to LO
- d. OPTICS COUPLING to DIRECT
- e. OPTICS TEL TRUN to SLAVE to SXT

- 6.2.12.4 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. After 15 seconds return the switch to OFF.
- 6.2.12.5 Resolution Checks
- 6.2.12.5.1 Sight through the SXT eyepiece. Using the OPTICS CONTROL STICK, adjust the SXT to obtain the best reflected field of view of the 5-inch autocollimator reticle engravings at the center of the field of view.
- 6.2.12.5.2 Note that the autocollimator reticle contains a series of lines of different thickness and width. Each set of lines is marked with a number (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines. The SXT resolution shall be at least 10 arc-seconds at the center of the field of view.
- 6.2.12.5.3 Repeat 6.2.12.5.1 and 6.2.12.5.2 using the SCT and the SCT resolution chart. The SCT shall have a resolution of at least 3 arc-minutes at the center of the field of view.
- 6.2.12.6 Slave Telescope Mode Checks
- 6.2.12.6.1 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.6.2 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the Control Indicator Panel to ZERO. Wait 15 seconds
- 6.2.12.6.3 Record the SCT Shaft and Trunnion angles as indicated by the TPAC and the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between the TPAC Shaft angle and the Shaft CDU angle shall be ± 0.11 degree or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be ± 0.22 degree or less.
- 6.2.12.6.4 Place the OPTICS ZERO switch to OFF. Using the OPTICS CONTROL STICK drive the SXT Shaft and Trunnion CDU's until $R1 = +035.00 \pm 0.10$ degree and $R2 = 35.000 \pm 0.100$ degree, setting the CONTROLLER SPEED switch to LO as the angles are approached. Press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles as indicated by the TPAC. Record R1 and R2. The difference between the TPAC Shaft angle and the Shaft CDU angle shall be ± 0.11 deg or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be ± 0.22 deg or less.

- 6.2.12.6.5 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO.
- 6.2.12.6.6 Set the OPTICS TEL TRUN switch to SLAVE to SXT position.
- 6.2.12.6.7 Remove the plug from the base of the SXT eyepiece and install the Adapter Assembly and Portable Light Assembly. Turn on the light.
- NOTE: If needed to reduce external light, place a photographer's hood over the optics head and retroreflecting prism.
- 6.2.12.6.8 Sight through the SCT eyepiece and provide direction to personnel outside spacecraft for positioning the Retroreflecting Prism, Model No. A23-200, to span between the SXT LLOS and SCT LOS such that the illumination from the back-light filament is clearly visible at the center of the field of view. Prism must be held in this alignment position until completion of Step 6.2.12.6.11.
- 6.2.12.6.9 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Note the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement, expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. For instance, the outer ends of the SXT reticle lines are 6% from center. Displacement shall be less than 50% (bar must be closer to center than to edge of field of view).
- 6.2.12.6.10 Set the OPTICS TEL TRUN switch to 0° position.
- 6.2.12.6.11 Again direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in Step 6.2.12.6.9. Place the OPTICS MODE switch to MAN and observe the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. Displacement shall be less than 50%.
- 6.2.12.6.12 Remove the Retroreflecting Prism.
- 6.2.12.6.13 Replace the Portable Light in the adapter on the SXT eyepiece.
- 6.2.12.6.14 While sighting into the SCT eyepiece, set the OPTICS TEL TRUN switch to 25 deg. and observe that the resolution pattern mounted outside the spacecraft appears to move downward from the center of the field of view to the zero reticle marking that is 25 deg. below the center of the field of view.
- 6.2.12.6.15 Record the TPAC Trunnion Angle. It shall be $25.00^\circ \pm .25^\circ$.

- 6.2.12.6.16 Set the OPTICS TEL TRUN switch to SLAVE TO SXT. Set the OPTICS ZERO switch to OFF.
- 6.2.12.7 SXT Parallelism Tests
- 6.2.12.7.1 Using the OPTICS CONTROL STICK drive the SXT StLOS Trunnion to $+15.000 \pm 2$ degree as indicated in R2 of the DSKY. Maintain a Shaft CDU angle of 000.00 ± 0.10 degree as indicated by R1 on the DSKY.
- 6.2.12.7.2 Sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to superimpose the SXT LLOS horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.
- 6.2.12.7.3 Repeat 6.2.12.7.2 twice. Calculate and record the average of the three autocollimator readings.
- 6.2.12.7.4 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO.
- 6.2.12.7.5 Again sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to bring the SXT StLOS horizontal reticle and autocollimator horizontal filar images to coincide. Record the autocollimator reading.
- 6.2.12.7.6 Repeat 6.2.12.7.5 twice. Calculate and record the average of the three autocollimator readings. The average value obtained here shall not differ from that obtained in 6.2.12.7.3 by more than 10 arc-seconds.
- 6.2.12.7.7 Set the OPTICS-ZERO switch to OFF. Using the OPTICS CONTROL STICK drive the SXT Trunnion angle to 85.000 ± 5 degrees as indicated on R2 of the DSKY. Set the OPTICS SPEED to LO and drive the SXT Trunnion to $+90.000 \pm 0.100$ degrees as indicated on R2 of the DSKY. Insure that the SXT Shaft angle remains at 000.00 ± 0.10 degrees as indicated by R1 on the DSKY.
- 6.2.12.7.8 Sight through the SXT. Two reticle patterns shall be visible. Use the OPTICS CONTROL STICK to adjust the SXT Trunnion angle until the two horizontal reticle lines are coincident. Record the Trunnion CDU angle displayed in R2. The Trunnion CDU angle shall be 90.000 ± 0.010 degrees.
- 6.2.12.7.9 Remove the Portable Light Assembly and Adapter Assembly from the base of the SXT eyepiece. Replace the SXT eyepiece plug.
- NOTE: If Optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.
- 6.2.12.8 Shaft and Trunnion Positional Accuracy Checks
- 6.2.12.8.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. After 15 seconds, return the selector to OFF.
- 6.2.12.8.2 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton.

- 6.2.12.8.3 Sight through the SXT. Using the control stick align the SXT SLOS with optical target No. 1 on the G&N Installation Fixture Model No. A23-097. Set the OPTICS SPEED switch to LO as the target is approached. When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.
- 6.2.12.8.4 Sight through the SXT. Using the control stick align the SXT SLOS with optical target No. 2 on A23-097. Set the OPTICS SPEED switch to LO as the target is approached.
- 6.2.12.8.5 When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.
- 6.2.12.8.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. After 15 seconds set the switch to OFF. Set the OPTICS MODE switch to CMC.
- 6.2.12.8.7 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.8 Enter the value recorded from R1 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.9 Enter the value recorded from R2 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.10 Sight through the SXT. The SLOS should be centered on Optical Target No. 1 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.3 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.11 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.12 Enter the value recorded from R1 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.13 Enter the value recorded from R2 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.14 Sight through the SXT. The SLOS should be centered on Optical Target No. 2 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.5 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.15 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. After 15 seconds return the switch to OFF.

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- 6.2.12.8.16 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start 3 times. Press the ENTER pushbutton after each entry.
- 6.2.13 Optics Slew Rate Test
- NOTE: Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.13.1 Set/Verify the G/N POWER-OPTICS switch on the LFR Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.
- 6.2.13.2 Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.
- VERB 41 NOUN 20, ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER
- 6.2.13.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the positions indicated.
- TEL TRUN to SLAVE to SXT
 - OPTICS COUPLING to DIRECT
 - OPTICS SPEED to HI
 - OPTICS MODE to MAN
- 6.2.13.4 Monitor MARK COMMAND by entering VERB 06 NOUN 56 into K-148. Press the ENTER pushbutton.
- TRUNNION SLEW RATE - HI SPEED
- 6.2.13.5 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees to zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch on the G&N Indicator Control Panel to OFF.
- NOTE: Read and understand step 6.2.13.6 before proceeding. Do not hold Control Stick at upper limit more than 10 seconds, or exceed a trunnion angle of 85 degrees.
- 6.2.13.6 Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds.

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(before display changes). The data displayed is in the following form:

- a. R2 = ±XX.XXX (Trunnion LOS angle in deg)
- b. R3 = +XXX.XX (Time in seconds)

After the display has changed, again record the value of R2 and R3.

6.2.13.7

Perform the following calculations:

NOTE: In performing calculation b. below, and in similar calculations throughout this test procedure, the following shall be noted and taken into account. It is possible that the second R3 reading may be smaller than the first reading. If so, add an overflow time value of 163.84 sec to the second reading and then subtract the first reading, in order to obtain Δ time as the difference of the two R3 readings.

- a. Difference between R2 displays = _____ (Δ trun. angle)
- b. Difference between R3 displays = _____ (Δ time)
- c. $\frac{\Delta \text{trun. angle}}{\Delta \text{time}} = \text{---}^\circ \text{---} \text{deg/sec}$

The trunnion slew rate shall be 10±2 deg/sec.

SHAFT SLEW RATE - HI SPEED

6.2.13.8

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand step 6.2.13.9 before proceeding. Do not hold Control Stick at right limit for more than 10 seconds, or exceed a shaft angle of 250 degrees.

6.2.13.9

Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 sec (before display changes). The data displayed is in the following form:

- a. R1 = ±XXX.XX (Shaft angles in deg.)
- b. R3 = +XXX.XX (Time in seconds.)

After the display has changed, again record the values of R1 and R3.

6.2.13.10

Perform the following calculations:

- a. Difference between R1 displays = ____ (Δ shaft angle)
- b. Difference between R3 displays = ____ (Δ time)
- c. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \text{____ deg/sec}$

The Shaft Slew Rate shall be 19.5 ± 3.9 deg/sec
TRUNNION SLEW RATE - MED SPEED

6.2.13.11

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Set the OPTICS SPEED switch to MED. Monitor MARK command by entering VERB 06 NOUN 56 in KI48. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.12 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

6.2.13.12

Record the SXT TRUN MTR control winding (CG 3155) signal on the CRT while slewing the optics. The voltage shall be +0.25 to +2.00 VRMS. Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R2 = ±XX.XXX (Trunnion LOS angle in deg)
- b. R3 = +XXX.XX (Time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.13

Perform the following calculations:

- a. Difference between R2 displays = ____ (Δ trunnion angle)
- b. Difference between R3 displays = ____ (Δ time)
- c. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}} = \text{____ deg/sec}$

The Trunnion Slew Rate shall be 1.0 ± 0.2 deg/sec.

SHAFT SLEW RATE - MED SPEED

6.2.13.14

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to MAN. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.15 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.15

Record the SXT SHAFT MTR control winding (CG 3145) signal on the CRT while slewing the optics. The voltage shall be +0.50 to +4.00 VRMS. Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R1 = +XXX.XX (Shaft angles in deg)
- b. R3 = +XXX.XX (Time in seconds)

After the display has changed, again record the values of R1 and R3.

6.2.13.16

Perform the following calculations:

- a. Difference between R1 displays = ____ · ____ (Δ shaft angle)
- b. Difference between R3 displays = ____ · ____ (Δ time)
- c. $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{---} \cdot \text{---} \text{ deg/sec}$

The Shaft Slew Rate shall be $2.0 \pm 0.4 \text{ deg/sec}$.

TRUNNION SLEW RATE - LO SPEED

6.2.13.17

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Set the OPTICS SPEED switch to LO. Monitor MARK command by entering the VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.18 before proceeding. Do not hold control stick at upper limit for more than 30 seconds.

6.2.13.18

Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 sec (before display changes). The data displayed is in the following form:

- a. R2 = ±XX.XXX (Trunnion LOS angle in deg)
- b. R3 = +XXX.XX (Time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.19

Perform the following calculations:

- a. Difference between R2 displays = ____ · ____ (Δ trunnion angle)
- b. Difference between R3 displays = ____ · ____ (Δ time)
- c. $\frac{\Delta \text{trunnion angle}}{\Delta \text{time}} = \text{---} \cdot \text{---} \text{ deg/sec.}$

The Trunnion Slew Rate shall be 0.10±0.02 deg/sec.

SHAFT SLEW RATE - LO SPEED

6.2.13.20

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the EXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to EXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Monitor MARK command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.21 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.21

Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 sec (before display changes). The data displayed is in the following form:

- a. R1 = ±XXX.XX (Shaft angle in deg)
- b. R3 = +XXX.XX (Time in seconds)

After the display has changed, again record the values of R1 and R3.

6.2.13.22

Perform the following calculations:

- a. Difference between R1 displays = ____ · ____ (Δ shaft angle)
- b. Difference between R3 displays = ____ · ____ (Δ time)
- c. $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{---} \cdot \text{---} \text{ deg/sec}$

The Shaft Slew Rate shall be 0.20±0.04 deg/sec.

OPTICS HAND CONTROLLER DRIFT RATE CHECK - LO SPEED

6.2.13.23

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF.

6.2.13.24

Press the MARK pushbutton and record the display in R1, R2 and R3. Approximately 60 seconds after the first MARK, again press the MARK pushbutton and record the new data displayed in R1, R2, and R3. The data displayed is in the following form:

- a. R1 = ±XXX.XX (Shaft angle in deg)
- b. R2 = ±XX.XXX (Trunnion LOS angle in deg)
- c. R3 = +XXX.XX (Time in seconds)

6.2.13.25

Perform the following calculations:

- a. Difference between R1 displays = _____ (Δ shaft angle)
- b. Difference between R2 displays = _____ (Δ trunnion angles)
- c. Difference between R3 displays = _____ (Δ time)
- d. $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{_____ deg/sec}$ (shaft drift rate)
shall be less than 0.0333 deg/sec.
- e. $\frac{\Delta \text{trunnion angle}}{\Delta \text{time}} = \text{_____ deg/sec}$ (trunnion drift rate)
shall be less than 0.0167 deg/sec.

6.2.13.26

Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.17 SXT-NB-IMU Fine Alignment Test

6.2.17.1 Perform Master Initialization 6.2.5.3 before proceeding.

6.2.17.2 Prior to performing this test, the G&N Installation Qualification fixture shall be installed on the supporting fixture and adjusted to permit proper operation of the G&N optics. The azimuth supplied by the azimuth autotest (Optical Reference No. 1) shall be known to ± 30 minutes of arc.

NOTE: The G&N shall have had OPERATE power applied for a minimum of 1 hour. Set the G/N POWER-OPTICS switch to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0 \pm 3.0 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG1211) and OPTIX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.

6.2.17.3 Enter VERB 01 NOUN 10 into K148. Press the ENTER pushbutton. Enter 00003 into K148. Press the ENTER pushbutton. Record R1 = AAAAA.

If the recorded value is within any of the sets of limits given in Table 1 proceed with the test. If the recorded value is NOT within any of the sets of limits wait 30 minutes and then repeat this step.

TABLE I

MIN VALUE				MAX VALUE
00000	<	AAAAA	<	03242
04000	<	AAAAA	<	07242
10000	<	AAAAA	<	13242
14000	<	AAAAA	<	17242
20000	<	AAAAA	<	23242
24000	<	AAAAA	<	27242
30000	<	AAAAA	<	33242
34000	<	AAAAA	<	37242

6.2.17.4 Enter the following sequence into the Lower Equipment Bay (LEB) DSKY.

- a. VERB 41 NOUN 20 ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.17.5 On the G&N Indicator Control Panel set the following switches to the position indicated.

- a. OPTICS TEL TRUN to SLAVE to SXT
- b. OPTICS COUPLING to DIRECT
- c. OPTICS SPEED to LO
- d. OPTICS MODE to MAN

6.2.17.5.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC. Set OPTICS ZERO to ZERO.

- 6.2.18.9 Gyrocompassing Stability
- 6.2.18.9.1 Enter VERB 33, ENTER into the DSKY. On the DSKY observe the PROGRAM display change to 05 after approximately 90 seconds. Approximately 5 minutes later observe the PROGRAM display change to 02. When PROG display changes to 02 record time as T_0 .
- 6.2.18.9.2 120 minutes after T_0 record the Outer, Inner and Middle CDU Gimbal angles from the CRT.
- 6.2.18.9.3 Repeat above step every 5 minutes for the next 120 minutes.
- 6.2.18.9.4 The peak-to-peak spread of the outer gimbal angle shall not exceed 0.12 degrees.
- 6.2.18.9.5 The peak-to-peak spread of the Inner and Middle gimbal angles shall not exceed 0.06 degrees.
- 6.2.18.10 Gyrocompassing Accuracy
- 6.2.18.10.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Between 235 minutes and 240 minutes from T_0 set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.10.2 Enter the following into the DSKY.
- VERB 21 NOUN 03 ENTER
 - 02663 ENTER
 - +XXX.XX±000.01 ENTER (Target No. 1 Az)
 - Press ENTER Pushbutton
 - 02664 ENTER
 - +XXX.XX±000.01 ENTER (Target No. 2 Az)
 - Press ENTER Pushbutton
 - 02665 ENTER
 - +00.000 ENTER (Target No. 1 EL)
 - Press ENTER Pushbutton
 - 02666 ENTER
 - +00.000 ENTER (Target No. 2 EL)
- On the G&N Indicator Control Panel set the OPTICS ZERO switch to OFF, set the OPTICS MODE switch to MAN and the OPTICS SPEED switch to HI. Drive the StLOS to the approximate position of Target No. 1. Set the OPTICS SPEED Switch to LO.
- NOTE: Read the following 10 steps before proceeding. These are time critical steps and must be performed as rapidly as possible.
- 6.2.18.11 After 240 minutes from T_0 enter VERB 52 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT change to 03.

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- 6.2.18.17 After the correct readings for R1 and R2 are verified enter VERB 33 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.18 Using the Optics Hand Controller, align the SXT StLOS to target 1 and press the MARK pushbutton. If satisfied that the MARK was good, proceed. If not satisfied with MARK, press the MARK REJECT pushbutton and repeat the step.
- 6.2.18.19 Set the OPTICS SPEED switch to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target No. 2.
- 6.2.18.20 Set the OPTICS SPEED switch to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 2 and press the MARK pushbutton. If satisfied that the MARK was good, press the ENTER pushbutton. If not satisfied, press the MARK REJECT pushbutton and repeat this step.
- 6.2.18.21 On the CRT observe the following data displayed:
- VERB 06 NOUN 60
 - R1 = $\pm xx.xxx$ (X gyro elevation error, degrees)
 - R2 = $\pm xx.xxx$ (Y gyro elevation error, degrees)
 - R3 = $\pm xx.xxx$ (Z gyro azimuth error, degrees)
- Record R1, R2 and R3.
- 6.2.18.22 Enter VERB 34 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT and DSKY's indicate 02. Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.23 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.24 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start three times. Press the ENTER pushbutton after each entry. Set the G/N POWER OPTICS Switch on the LEB Lighting Control Panel to OFF.

- 6.2.20.3.29 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the Indicator Control Panel to ZERO for 30 seconds, then return to OFF.
- 6.2.20.3.30 Insert in K148
- a. VERB 33, ENTER
- 6.2.20.3.31 Observe on CRT
- a. V 06 N 02 Flashing
b. R1 -00135
c. R2 +00135
d. R3 +00003
- 6.2.20.3.32 Record CRT indications
- a. CG 3722 TRUNNION CDU DAC OUTPUT -3.56±0.36 VRMS
b. CG 3721 SHAFT CDU DAC OUTPUT +3.56±0.36 VRMS
- 6.2.20.3.33 Insert in K148
- a. VERB 33, ENTER
- 6.2.20.3.34 Observe on CRT
- a. V 06 N 02 Flashing
b. R1 -00160
c. R2 +00160
d. R3 +00003
- 6.2.20.3.35 Record CRT indications
- a. CG 3722 TRUNNION CDU DAC OUTPUT -4.22±0.42 VRMS
b. CG 3721 SHAFT CDU DAC OUTPUT +4.22±0.42 VRMS
- 6.2.20.3.36 Insert in K148
- a. VERB 33, ENTER
- 6.2.20.3.37 Observe on CRT
- a. V 06 N 02 Flashing
b. R1 -00384
c. R2 +00384
d. R3 +00003

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- Addition 5.** Paragraph 6.1.2.1., add new Paragraph 6.1.2.1.5 as follows:
- 6.1.2.1.5** Data from the on-board tape recorder shall be made available and the following signals verified.
- a. VIB NB ROLL (CG 6001)
 - b. VIB NB PITCH (CG 6002)
 - c. VIB NB YAW (CG 6003)
- Addition 6.** Replace Paragraph 6.2.3.1.13 with the following:
- 6.2.3.1.13** 30 minutes after switching from Standby mode to the Operate mode record the IRIG temperature. The recorded IRIG temperature shall be within 0.5 deg F. of the Operate stabilized IRIG temperature determined below.
- Add the following sentence to Paragraph 6.2.3.1.14:
- Record the Operate mode stabilized IRIG temperature. The Operate mode stabilized IRIG temperature shall be $135 \pm 2.5^\circ \text{F}$.
- Paragraph 6.2.5.2.16, add the following to Table VI:
- 14 CG 2301 IRIG TEMPERATURE
- Addition 7.** Paragraph 6.1.1.6, add item "f" as follows:
- f. The TRACKER switch on G&N Indicator Control Panel shall be set to OFF.
- Addition 8.** Replace Paragraph 6.2.3.1.2 with the following:
- 6.2.3.1.2** Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Switch and selectors on the G&N Indicator Control Panel shall be set as follows.
- a. OPTICS MODE to ZERO
 - b. CONTROLLER COUPLING to DIRECT
 - c. CONTROLLER SPEED to MED
 - d. TELESCOPE TRUNNION to SLAVE to SXT
 - e. RETICLE BRIGHTNESS to minimum brightness position
- Addition 9.** Replace Paragraph 6.2.5.1.2 with the following:
- 6.2.5.1.2** Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the

following switches on the G&N Indicator Control Panel to the positions designated.

- a. OPTICS MODE to ZERO
- b. CONTROLLER MODE to DIRECT
- c. CONTROLLER SPEED to LO
- d. TELESCOPE TRUNNION to SLAVE to SXT
- e. RETICLE BRIGHTNESS to minimum brightness position

Addition 10. Replace Paragraph 6.2.5.2.1 with the following:

6.2.5.2.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set or verify the following G&N Indicator Control Panel switches to the position indicated.

- a. CONDITION LAMPS to ON
- b. OPTICS MODE to ZERO
- c. CONTROLLER COUPLING to DIRECT
- d. CONTROLLER SPEED to LO
- e. TELESCOPE TRUNNION to SLAVE to SXT
- f. RETICLE BRIGHTNESS to minimum brightness position

Addition 11. Replace Paragraph 6.2.5.3.6 with the following:

6.2.5.3.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Insure that the following switches are set to the positions indicated:

- a. CONTROLLER COUPLING to DIRECT
- b. OPTICS MODE to ZERO
- c. TELESCOPE TRUNNION to SLAVE to SXT
- d. TRACKER to OFF
- e. CONTROLLER SPEED to LO
- f. CONDITION LAMPS to ON
- g. UP TELEMETRY to ACCEPT

Addition 12. Replace Paragraph 6.2.9.23 with the following:

6.2.9.23 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to CMC.

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Addition 13. Replace Sections 6.2.10 through 6.2.13 with the following:

6.2.10 Zero Optics Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2 Turn On Procedure before proceeding.

INITIALIZATION

6.2.10.1 Set the G/N POWER - OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.10.2 Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.

- a. VERB 41, NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.10.3 Insure that the following switches on the G&N Indicator Control Panel are set as follows:

- a. TELESCOPE TRUNNION to SLAVE to SXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to HI

OPTICS ZERO MODE TEST

6.2.10.4 Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K-148. Press the ENTER pushbutton.

6.2.10.5 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds; Verify the Optics have zeroed properly by observing the following on R1 and R2 of the DSKY.

- a. R1 = +0.00° +0.02° , -0.03° (Shaft Angle)
- b. R2 = +0.000° +0.006° , -0.007° (Trunnion LOS Angle)

- 6.2.10.5.1 Enter the following

VERB 01 NOUN 10, ENTER
00033, ENTER
Verify R1 = XXX6X

- 6.2.10.5.2 Set the OPTICS MODE switch to CMC. Enter the following:

ENTER
00033, ENTER
Verify R1 = XXX5X

- 6.2.10.5.3 Set the OPTICS MODE switch to MAN. Press the KEY REL pushbutton on the DSKY.

OPTICS BACKUP MODE TEST

- 6.2.10.6 Insert the Inflight Tool (V36601408) into the Trunnion Tool input and engage drive mechanism (button out). Verify that the trunnion turns by viewing the movement through the SCT eyepiece while turning the tool until the TPAC reads +6 deg. Remove the tool from the trunnion tool input.

- 6.2.10.7 Insert the Inflight Tool (V36601405) into the Shaft Tool input and engage the drive mechanism (button out). Verify that the Shaft turns by viewing the movement through the SCT eyepiece while turning the tool so that the shaft moves through an angle from 0° to +3 to -3 to 0 as indicated on the shaft TPAC. Disengage the shaft drive mechanism (button in) and remove the tool.

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6.2.10.8 8 Insert the Inflight Tool (V36601405) into the Trunnion Tool input. Verify that the Trunnion Turns by viewing the movement through the SCT eye-piece while turning the tool so that the trunnion moves from +3° to -5° and back to zero as indicated on the Trunnion TPAC. Disengage the trunnion drive mechanism (button in) and remove the tool.

6.2.11 Optics Coordinate Transformation Control Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure before proceeding.

INITIALIZATION

6.2.11.1 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.11.2 Enter the following into the K-Start. Press the ENTER pushbutton after each entry:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.11.3 Verify and/or set the following switches on the G&N Indicator control panel to the position indicated.

- a. TELESCOPE TRUNNION to SLAVE to EXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to HI

6.2.11.4 Set up the analog recorders to monitor the following measurements.

- a. CG 3170 SCT Trunnion Tachometer Output

6.2.11.5 Enter the following into the K-Start to monitor the OPTICS CDU's.

VERB 16 NOUN 55, press ENTER

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- 6.2.11.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the G&N Panel to ZERO. Wait 15 seconds. Return the OPTICS MODE switch to MAN.
- RESOLVED MODE PHASING AND IMAGE RATE TEST
- 6.2.11.7 Using the Optics Control Stick, drive the Optics until R1 = +225.00 and R2 = +10.000 on the CRT and the DSKY's.
- 6.2.11.8 Set the CONTROLLER COUPLING switch on the G&N Panel to RSLV and CONTROLLER SPEED switch to MED.
- 6.2.11.9 Position the movable optics target such that it is centered on the SCT reticle pattern, then start the analog recorders at a chart speed of 10 mm/second.
- 6.2.11.10 Quickly displace the Optics Control Stick 45 ± 10 degrees in the upper right hand quadrant while sighting on the optics target through the SCT eyepiece. The target shall appear to move in the upper right field of view of the SCT at 45 ± 10 deg. When target leaves the SCT upper right field of view press MARK pushbutton and immediately record the shaft angle as displayed on R1 of the DSKY. The recorded shaft angle shall be $+225 \pm 10.00$ degrees.
- 6.2.11.11 Stop the analog recorder and measure the elapsed time between the initial and the final signal null conditions for the Trunnion measurement. The elapsed time shall be +19 to +32 seconds.
- CSM AMPLIFIER SHAFT AND TRUNNION DRIVE TEST
- 6.2.11.12 Set the CONTROLLER COUPLING switch to DIRECT. Again using the Optics Control Stick, drive the optics until R1 = +225.00 and R2 = +10.000. Set the CONTROLLER COUPLING switch to RSLV.
- 6.2.11.13 While sighting on the optical target through the SCT eyepiece, displace the Optics Control stick fully to the right. Verify that the target image appears to move in a straight line horizontally to the right and release the Optics Control Stick when the target image reaches the edge of the SCT field of view.
- 6.2.11.14 Enter VERB 34 in the DSKY. Press the ENTER pushbutton.

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6.2.11.15 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the CONTROLLER COUPLING switch on the G&N Panel to DIRECT. Set the OPTICS MODE switch to ZERO. After 15 seconds, return the switch to MAN.

NOTE: If optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.12 Optics Functional Test

Proceed with this test if 6.2.3 Operate Power On Test, or 6.2.5.2 Turn-on Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding.

NOTE: This test requires the use of the G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT StLOS before proceeding. Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.

6.2.12.1 Set/verify the G/N POWER OPTICS switch on the LEB Lighting Control Panel to OPTICS. Set TRACKER switch to OFF. Verify the following:

- +28 VDC OPTX OPERATE BUS (CG 1530) is 28.8±3 VDC. Record the indication on the CRT.
- CG 1211 OPTX 28V 800 cps 1% 0 ph not flashing on CRT.
- CG 1212 OPTX 800 cps 5% -90 ph not flashing on CRT.

6.2.12.2 Enter the following sequence into the K-Start.

- VERB 41, NOUN 20, ENTER
- +00000, ENTER
- +00000, ENTER
- +00000, ENTER

6.2.12.3 Insure that the optics control switches on the G&N Indicator Control Panel are set as follows:

- OPTICS MODE to MAN
- CONTROLLER SPEED to LO
- CONTROLLER COUPLING to DIRECT
- TELESCOPE TRUNNION to SLAVE to SXT

- 6.2.12.4 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN.
- 6.2.12.5 Resolution Checks
- 6.2.12.5.1 Sight through the SXT eyepiece. Using the Optic Control Stick, adjust the SXT to obtain the best reflected field of view of the 5-inch autocollimator reticle engraving at the center of the field of view.
- 6.2.12.5.2 Note that the autocollimator reticle contains a series of lines of different thickness and width. Each set of lines is marked with a number (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines. The SXT resolution shall be at least 10 arc-seconds at the center of the field of view.
- 6.2.12.5.3 Repeat 6.2.12.5.1 and 6.2.12.5.2 using the SCT and the SCT resolution chart. The SCT shall have a resolution of at least 3 arc-minutes at the center of the field of view.
- 6.2.12.6 Slave Telescope Mode Checks
- 6.2.12.6.1 Enter VERB 16 NOUN 56 into the K-Start, press the ENTER pushbutton.
- 6.2.12.6.2 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the Control Indicator Panel to ZERO. Wait 15 seconds.
- 6.2.12.6.3 Record the SCT Shaft and Trunnion angles as indicated by the TPAC and the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between the TPAC shaft angle and the Shaft CDU angle shall be ± 0.11 deg or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be ± 0.22 deg or less.

- 6.2.12.6.4 Place the OPTICS MODE switch to MAN. Using the Optics Control Stick drive the SXT Shaft and Trunnion CDU's until $R1 = 035.00 \pm 0.10$ deg and $R2 = +35.00 \pm 0.100$ deg, setting the CONTROLLER SPEED switch to LO as the angles are approached. Press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles as indicated by the TPAC. Record $R1$ and $R2$. The difference between the TPAC Shaft angle and Shaft CDU angle shall be ± 0.11 deg or less. The difference between the TPAC Trunnion angle and Trunnion CDU angle shall be ± 0.22 deg or less.
- 6.2.12.6.5 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO.
- 6.2.12.6.6 Set the TELESCOPE TRUNNION switch to SLAVE to SXT position.
- 6.2.12.6.7 Remove the plug from the base of the SXT eyepiece and install the Adapter Assembly and Portable Light Assembly. Turn on the light.
- NOTE: If needed to reduce external light, place a photographer hood over the optics head and retroreflecting prism.
- 6.2.12.6.8 Sight through the SCT eyepiece and provide direction to personnel outside spacecraft for positioning the Retroreflecting Prism, Model No. A23-200, to span between the SXT LOS and SCT LOS such that the illumination from the back-light filament is clearly visible at the center of the field of view. Prism must be held in this alignment position until completion of step 6.2.12.6.11.
- 6.2.12.6.9 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Note the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement, expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. For instance, the outer ends of the SXT reticle lines are 6% from center. Displacement shall be less than 50% (bar must be closer to center than to edge of field of view).
- 6.2.12.6.10 Set the TELESCOPE TRUNNION switch to 0° position.
- 6.2.12.6.11 Again direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in Step 6.2.12.6.9. Place the OPTICS MODE switch to MAN and observe the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement, expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. Displacement shall be less than 50%.
- 6.2.12.6.12 Remove the Retroreflecting Prism.

- 6.2.12.6.13 Replace the Portable Light in the adapter on the SXT eyepiece.
- 6.2.12.6.14 While sighting into the SCT eyepiece, set the TELESCOPE TRUNNION switch to 25° and observe that the resolution pattern mounted outside the spacecraft appears to move downward from the center of the field of view to the zero reticle marking that is 25° below the center of the field of view.
- 6.2.12.6.15 Record the TPAC Trunnion Angle. It shall be 25.00 ± 0.22 deg.
- 6.2.12.6.16 Set the TELESCOPE TRUNNION switch to SLAVE to SXT.
- 6.2.12.7 SXT Parallelism Tests
- 6.2.12.7.1 Using the Optics Control Stick drive the SXT SLOS Trunnion to $+15.000^\circ \pm 2^\circ$ as indicated in R2 of the DSKY. Maintain a Shaft CDU angle of 000.00 ± 0.10 degrees as indicated by R1 of the DSKY.
- 6.2.12.7.2 Sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to superimpose the SXT LLOS horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.
- 6.2.12.7.3 Repeat 6.2.12.7.2 twice. Calculate and record the average of the three autocollimator readings.
- 6.2.12.7.4 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 8 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO.
- 6.2.12.7.5 Again sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to bring the SXT SLOS horizontal reticle and autocollimator horizontal filar images to coincide. Record the autocollimator reading.
- 6.2.12.7.6 Repeat 6.2.12.7.5 twice. Calculate and record the average of the three autocollimator readings. The average value obtained here shall not differ from that obtained in 6.2.12.7.3 by more than 10 arc-seconds.
- 6.2.12.7.7 Set the OPTICS MODE switch to MAN. Using the Optics Control Stick drive the SXT Trunnion angle to 85.00 ± 5 degrees as indicated on R2 of the DSKY. Set the CONTROLLER SPEED switch to LO and drive the SXT Trunnion to $+90.000$ degrees ± 0.100 degree as indicated on R2 of the DSKY. Insure that the SXT Shaft angle remains at 000.00 ± 0.10 degree as indicated by R1 on the DSKY.
- 6.2.12.7.8 Sight through the SXT. Two reticle patterns shall be visible. Use the Optics Control Stick to adjust the SXT Trunnion angle until the two horizontal reticle lines are coincident. Record the Trunnion CDU angle displayed in R2. The Trunnion CDU angle shall be 90.000 ± 0.10 degrees.
- 6.2.12.7.9 Remove the Portable Light Assembly and Adapter Assembly from the base of the SXT eyepiece. Replace the SXT eyepiece plug.

NOTE: If optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

- 6.2.12.8 Shaft and Trunnion Positional Accuracy Checks
- 6.2.12.8.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds, return the selector to Manual.
- 6.2.12.8.2 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.3 Sight through the SXT. Using the control stick align the SXT SLOS with optical Target No. 1 on the G&N Installation Fixture Model A23-097. Set the CONTROLLER SPEED switch to LO as the target is approached. When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.
- 6.2.12.8.4 Sight through the SXT. Using the control stick align the SXT SLOS with Optical Target No. 2 on A23-097. Set the CONTROLLER SPEED switch to LO as the target is approached.
- 6.2.12.8.5 When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.
- 6.2.12.8.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds set the switch to CMC.
- 6.2.12.8.7 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.8 Enter the value recorded from R1 in 6.2.12.8.3 into the K-Start. Press the enter pushbutton.
- 6.2.12.8.9 Enter the value recorded from R2 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.10 Sight through the SXT. The SLOS should be centered on Optical Target No. 1 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.3 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.11 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.12 Enter the value recorded from R1 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.

- 6.2.12.8.13 Enter the value recorded from R2 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.14 Sight through the SXT. The SLOS should be centered on Optical Target No. 2 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 4.2.12.8.5 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.15 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MANUAL.
- 6.2.12.8.16 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start 3 times. Press the ENTER pushbutton after each entry.
- 6.2.13 Optics Slew Rate Test
- NOTE: Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.13.1 Set/verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CB 1530) is +28.0±3.0 VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT. Set TRACKER switch to OFF.
- 6.2.13.2 Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.
- a. VERB 41 NOUN 20, ENTER
 - b. +00000, ENTER
 - c. +00000, ENTER
 - d. +00000, ENTER
- 6.2.13.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the positions indicated.
- a. TELESCOPE TRUNNION to SLAVE to SXT
 - b. CONTROLLER COUPLING to DIRECT
 - c. CONTROLLER SPEED to HI
- 6.2.13.4 Monitor MARK Command by entering VERB 06 NOUN 56 into K-148. Press the ENTER pushbutton.

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6.2.13.4

TRUNNION SLEW RATE - HI SPEED

TRUNNION SLEW RATE - HI SPEED

6.2.13.5

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS MODE switch on the G&N Indicator Panel to MAN.

6.2.13.5.1

During the Trunnion Slew Rate Test HI Speed, monitor and verify the following signals on the CRT.

- a. SXT TRUNNION TACH O/P (CG 3150 LINK 2) shall be 3.3 ± 1.3 VRMS
- b. SCT TRUNNION TACH O/P (CG 3170 LINK 2) shall be -0.85 ± 0.35 VRMS

NOTE: Read and understand step 6.2.13.6 before proceeding. Do not hold Control Stick at upper limit more than 10 seconds, or exceed a trunnion angle of 85 degrees.

6.2.13.6

Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R2 = +XX.XXX (Trunnion LOS angle in deg)
- b. R3 = +XXX.XX (Time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.7

Perform the following calculations:

NOTE: In performing calculation b. below, and in similar calculations throughout this test procedure, the following shall be noted and taken into account. It is possible that the second R3 reading may be smaller than the first reading. If so, add an overflow time value of 163.84 sec to the second reading and then subtract the first reading, in order to obtain Δ time as the difference of the two R3 readings.

- a. Difference between R2 displays = _____ (Δ trunnion angle)
- b. Difference between R3 displays = _____ (Δ time)
- c. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}} = \text{--- deg/sec}$

The Trunnion Slew Rate shall be 10 ± 2 deg/sec.

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SHAFT SLEW RATE - HI SPEED

6.2.13.8 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

6.2.13.8.1 During the Shaft Slew Rate Test - Hi Speed, monitor and verify the following signals on the CRT.

- a. SXT SHAFT TACH O/P (CG 3140 Link 2) shall be 3.3±1.3 VRMS
- b. SCT SHAFT TACH O/P (CG 3160 Link 2) shall be 3.3±1.3 VRMS

NOTE: Read and understand step 6.2.13.9 before proceeding. Do not hold Control Stick at right limit for more than 10 seconds, or exceed a shaft angle of 250 degrees.

6.2.13.9 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R1 = +XXX.XX (shaft angles in deg)
- b. R3 = +XXX.XX (time in seconds)

After the display has changed, again record the values of R1 and R3.

6.2.13.10 Perform the following calculations:

- a. Difference between R1 displays = (Δ shaft angle)
- b. Difference between R3 displays = (Δ time)
- c. $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{--- deg/sec}$

The Shaft Slew Rate shall be 19.5±3.9 deg/sec.

TRUNNION SLEW RATE - MED SPEED

- 6.2.13.11 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to MED. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.12 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

- 6.2.13.12 Record the SXT TRUN MTR control winding (CG 3155) signal on the CRT while slewing the optics. The voltage shall be +0.25 to +2.00 VRMS. Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R2 = \pm XX.XXX (trunnion LOS angle in deg)
- b. R3 = +XXX.XX (time in seconds)

After the display has changed, again record the values of R2 and R3.

- 6.2.13.13 Perform the following calculations:

- a. Difference between R2 displays = $\text{---} \cdot \text{---}$ (Δ trunnion angle)
- b. Difference between R3 displays = $\text{---} \cdot \text{---}$ (Δ time)
- c. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}} = \text{---} \cdot \text{---} \text{ deg/sec}$

The Trunnion Slew Rate shall be $1.0 \pm 0.2 \text{ deg/sec}$.

SHAFT SLEW RATE - MED SPEED

- 6.2.13.14 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS Mode switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.15 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

- 6.2.13.15 Record the SXT SHAFT MTR control winding (CG 3145) signal on the CRT while slewing the optics. The voltage shall be +0.50 to +4.00 VRMS. Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R1 = \pm XXX.XX (shaft angle in deg)
- b. R3 = \pm XXX.XX (time in seconds)

After display has changed, again record the values of R1 and R3.

- 6.2.13.16 Perform the following calculations:

- a. Difference between R1 displays = ____ (Δ shaft angle)
- b. Difference between R3 displays = ____ (Δ time)
- c. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \text{____ deg/sec}$

The Shaft Slew Rate shall be 2.0 \pm 0.4 deg/sec.

TRUNNION SLEW RATE - LO SPEED

- 6.2.13.17 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the Controller SPEED switch to LO. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.
- 6.2.13.17.1 During the Trunnion Slew Rate Test-Lo Speed, monitor and verify the following signal on the CRT.

- a. TRUNNION CDU FINE ERROR (CG 3011 Link 2) \pm .07 VRMS MAX

NOTE: Read and understand 6.2.13.18 before proceeding. Do not hold control stick at upper limit for more than 30 seconds.

- 6.2.13.18 Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R2 = \pm XX.XXX (trunnion LOS angle in deg)
- b. R3 = \pm XXX.XX (time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.19 Perform the following calculations:

- a. Difference between R2 displays = XX.XXX (Δ trunnion angle)
- b. Difference between R3 displays = XXX.XX (Δ time)
- c. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}} = \text{--- deg/sec}$

The Trunnion Slew Rate shall be 0.10 ± 0.02 deg/sec

SHAFT SLEW RATE - LO SPEED

6.2.13.20 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Monitor MARK Command by entering Verb 06 NOUN 56 in K-148. Press the ENTER pushbutton.

6.2.13.20.1 During the Shaft Slew Rate Test - Lo Speed, monitor and verify the following signal on the CRT.

- a. SHAFT CDU FINE ERROR (CG 3021 Line 2) $\pm .07$ VRMS MAX

NOTE: Read and understand 6.2.13.21 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.21 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R1 = \pm XXX.XX (shaft angles in deg)
- b. R3 = \pm XXX.XX (time in seconds)

After the display has changed, again record the values of R1 and R3.

6.2.13.22 Perform the following calculations:

- a. Difference between R1 displays = --- (Δ shaft angle)
- b. Difference between R3 displays = --- (Δ time)
- c. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \text{--- deg/sec}$

The Shaft Slew Rate shall be 0.20 ± 0.04 deg/sec

OPTICS HAND CONTROLLER DRIFT RATE CHECK-LO SPEED

6.2.13.23 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

6.2.13.24 Press the MARK pushbutton and record the display in R1, R2, and R3. Approximately 60 seconds after the first MARK, again press the first MARK pushbutton and record the new data displayed in R1, R2 and R3. The data displayed is in the following form:

- a. R1 = aXXX.XX (shaft angle in deg)
- b. R2 = aXX.XXX (trunnion LOS angle in deg)
- c. R3 = +XXX.XX (time in seconds)

6.2.13.25 Perform the following calculations:

- a. Difference between R1 displays = _____ (Δ shaft angle)
- b. Difference between R2 displays = _____ (Δ trunnion angle)
- c. Difference between R3 displays = _____ (Δ time)
- d. $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{_____ deg/sec (Shaft Drift Rate)}$

Shall be less than 0.0333 deg/sec.

- e. $\frac{\Delta \text{trunnion angle}}{\Delta \text{time}} = \text{_____ deg/sec (Trunnion Drift Rate)}$

Shall be less than 0.0167 deg/sec.

6.2.13.26 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

Addition 14. Replace Paragraph 6.2.17.5 and 6.2.17.20 with the following:

6.2.17.5 On the G&N Indicator Control Panel, set the following switches to the position indicated.

- a. TELESCOPE TRUNNION to SLAVE to SXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to LO
- d. OPTICS MODE to MAN

6.2.17.20 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN. Enter VERB 33, ENTER into the DSKY.

Addition 15. Replace Paragraphs 6.2.18.10.1, 6.2.18.10.2, 6.2.18.19, 6.2.18.20, and 6.2.18.22 with the following:

6.2.18.10.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Between 235 minutes and 240 minutes from T₀ set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.

6.2.18.10.2 Enter the following into the DSKY:

- a. VERB 21 NOUN 03 ENTER
- b. 02663 ENTER
- c. +XXX.XX+000.01 ENTER (Target No. 1 Az)
- d. Press ENTER pushbutton
- e. 02664 ENTER
- f. +XXX.XX+000.01 ENTER (Target No. 2 Az)
- g. Press ENTER pushbutton
- h. 02665 ENTER
- i. +00.000 ENTER (Target No. 1 EL)
- j. Press ENTER pushbutton
- k. 02666 ENTER
- l. +00.000 ENTER (Target No. 2 EL)

On the G&N Indicator Control Panel, set the OPTICS MODE switch to MAN and the CONTROLLER SPEED switch to HI. Drive the St. LOS to the approximate position of Target No. 1. Set the CONTROLLER SPEED switch to LO.

NOTE: Read the following 10 steps before proceeding. These are time critical steps and must be performed as rapidly as possible.

6.2.18.19 Set the CONTROLLER SPEED switch to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target 2.

6.2.18.20 Set the CONTROLLER SPEED switch to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 2 and press the MARK pushbutton. If satisfied that the MARK was good, press the ENTER pushbutton. If not satisfied, press the MARK REJECT pushbutton and repeat this step.

- 6.2.18.22** Enter VERB 34 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT and DSKY's indicate 02. Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the G&N Indicator Control Panel to Zero.
- Addition 16.** Replace Paragraph 6.2.20.3.2, 6.2.20.3.22, and 6.2.20.3.29 with the following:
- 6.2.20.3.2** Set the OPTICS MODE selector on the Indicator Control Panel to MAN.
- 6.2.20.3.22** Set the OPTICS CONTROLLER SPEED switch on the Indicator Control Panel to HI.
- 6.2.20.3.29** Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the Indicator Control Panel to ZERO for 30 seconds, then return to MAN.

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ADDENDUM II

SCOPE: The following changes are required to make ND1002325 applicable as G&N System technical support documentation for systems containing SUNDIAL C test ropes. Refer to Drawing 2014999 to define further which test ropes and jumper modules shall be installed.

Change 1: Paragraphs 6.2.9.1.4, 6.2.9.2a, 6.2.9.3a, 6.2.9.5a, 6.2.9.6a, 6.2.9.7a, 6.2.9.8, 6.2.9.10a, 6.2.9.11a, 6.2.9.13a, 6.2.9.15a, 6.2.9.16a, 6.2.9.22. In each of these paragraphs change "VERB 06 NOUN XX flashing" to "VERB 33 NOUN XX flashing."

Change 2: Paragraphs 6.2.20.2.2a, 6.2.20.2.4a, 6.2.20.2.7a, 6.2.20.2.10a, 6.2.20.2.13a, 6.2.20.2.16a, 6.2.20.2.19a, 6.2.20.2.22a, 6.2.20.2.25a, 6.2.20.2.28a, 6.2.20.2.31a, 6.2.20.2.34a, 6.2.20.2.37a, 6.2.20.3.8a, 6.2.20.3.11a, 6.2.20.3.14a, 6.2.20.3.17a, 6.2.20.3.20a, 6.2.20.3.24a, 6.2.20.3.27a, 6.2.20.3.31a, 6.2.20.3.34a, 6.2.20.3.37a, 6.2.20.3.40a; in each of these steps, change "V06" to "V33".

Change 3: Paragraph 6.2.16.7.19 Change FROM: On K-148 enter the following sequence:

VERB 21	NOUN 01	ENTR
00407		ENTR
77757		ENTR
VERB 21	NOUN 01	ENTR
00411		ENTR
00020		ENTR
VERB 33		ENTR

Change TO: On K-148 enter the following sequence:

VERB 21	NOUN 01	ENTR
02502		ENTR
77757		ENTR
VERB 21	NOUN 01	ENTR
02504		ENTR
00020		ENTR
VERB 33		ENTR

Change 4: Paragraph 6.2.16.7.33 Change FROM: On K-148 enter the following sequence:

VERB 21	NOUN 01	ENTR
00405		ENTR
00020		ENTR
VERB 21	NOUN 01	ENTR
00407		ENTR
77757		ENTR
VERB 33		ENTR

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ADDENDUM II

Change 4
(Continued)

Change TO: On K-148 enter the following sequence:

VERB 21	NOUN 01	ENTR
02500		ENTR
00020		ENTR
VERB 21	NOUN 01	ENTR
02502		ENTR
77757		ENTR
VERB 33		ENTR

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ADDENDUM III

SCOPE. The following changes are required to make ND1002325 applicable on G&N System technical support documentation for CSM 2TV-1.

Change 1: Make the changes as specified in Additions 11 through 20 of Addendum I.
Delete the following paragraphs from Addition 17: 6.2.13.5.1, 6.2.13.8.1,
6.2.13.17.1, 6.2.13.20.1.

POST INSTALLATION CHECKOUT PROCESS
 SPECIFICATION FOR THE APOLLO GUIDANCE
 AND NAVIGATION SYSTEM - BLOCK II

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
12/21/67	G	35343	26, 33, 48, 50, 54	EA <i>SH/c</i>	—
2/28/68	H	35700	3, 4, 8, 11-13, 17, 21, 23, 25-27, 30-33, 38, 40-42, 47-51, 54, 61	EA	WLS
			62, 69-134: was 134 pages, now 158 pages. <i>EA/AC</i>		
4/4/68	J	36039	6, 69-71, 73-84, 106, 113, 115, 130, 135-158; was 158 pages, now 157 pages; total no. pages 158. <i>EA/AC</i>	EA	RJJ
4/18/68	K	36109	10, 15, 27, 31, 33, 42, 45, 51, 62, 76, 81, 82, 84, 113, 117-120, 149, 150	EA	WLS

This specification consists of pages 1 to 157 including Appendix I, pages 122-133, Addendum I, pages 134-154, Addendum II, pages 155-156 and Addendum III, page 157.

APPROVALS	Not required per CCA-497-0274	MIT/IL	R. D. Petryk	D. A. Ziemer
	NASA/MSC			
				AC

5.4.2 Failure of the D criteria for IRIG and PIPA parameters.

5.4.2.1 If D_1 , D_2 , or D_3 exceeds its maximum value as specified in Table D Paragraph 6.2.16.10.8 for any IRIG or PIPA, a retest sequence shall be initiated as indicated below:



The retest sequence shall be performed using the paragraphs indicated in Table I corresponding to the out-of-spec parameters. Table 2 indicates the test positions and other isolated parameters that must be recalculated and qualified.

If D_1 , D_2 , or D_3 exceeds its maximum value after the retest sequence is completed, the requirements of 5.4.2.2 (IRIG) or 5.4.2.3 (PIPA) shall apply. If D_1 , D_2 , and D_3 are within tolerances specified in Table D after the retest sequence is completed, the original out-of-tolerance D terms calculated in paragraph 6.2.16.10.8 shall be exonerated.

5.4.2.2 IRIG stability requirements

5.4.2.2.1 Failure to be within the maximum values for D_1 or D_2 or D_3 after the retest sequence shall constitute failure of the unit.

5.4.2.3 PIPA stability requirements

5.4.2.3.1 Failure to be within the maximum limits of D_1 or D_2 or D_3 after the retest sequence constitute failure of the unit.

5.4.2.3.2 If authority has been obtained to degauss a PIPA, then data taken prior to the degaussing of that PIPA shall not be used in the future to calculate stability terms. After degaussing, the retest sequence of Paragraph 5.4.2.1 must be performed.

5.5 Retest subsequent to replacement of a malfunctioned assembly with that of a flight certified assembly shall be at the discretion of NASA Engineering. Table II can be used as a guide to determine general retest requirements. In all retest procedures, the test sequence of Figure 1 shall be adhered to.

5.6 It is assumed that the Test Conductor has a working knowledge of the test equipment used; therefore, this procedure contains only the steps related directly to the G&N System components. If any questions arise concerning the test equipment, the Test Conductor should refer to the pertinent operational manuals.

5.7 The following requirements shall be completed before any of the tests in this specification are attempted.

5.7.1 The G&N System shall be Government Furnished Property.

5.7.2 The installation of the G&N System into the spacecraft shall have been completed as specified in Mechanical Installation Specification for Apollo Guidance Equipment Block II, MA0308-0107.

5.7.2.1 Interfacing systems (SCS, C & IS, EPS, ECS) shall have been verified to conform to loading and operational requirements as specified by the appropriate ICD.

5.7.3 All ACE equipment shall have been qualified in accordance with the respective quality assurance specifications prior to use with the G&N System.

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- 5.10 The test equipment listed in paragraph 4.1 shall be connected and ready for operation before the tests of this specification are initiated.
- 5.11 Data Records
- 5.11.1 All data concerning the checkout and operation of the G&N System as monitored via ACE, shall be recorded on the data sheets associated with their corresponding test. Out of tolerance readings shall be recorded and flagged by appropriate symbols.
- 5.11.1.1 All test data obtained while demonstrating the requirements of this document shall be permanently recorded and forwarded with the tested G&N to the next receiving agency.
- 5.11.1.2 A record of the amount of time each of the four prime power busses are on shall be kept and forwarded with the G&N to the next receiving agency.
- 5.12 Interface
- 5.12.1 The APOLLO G&N System shall interface with accepted ECS and EPS distribution systems for power and environment control purposes and with the SCS or SCS substitute system for signal interface in accordance with the applicable ICD's.
- 5.13 General System Operating Characteristics
- 5.13.1 The DSKY "NO ATT" lamp and PGNS light (GNIC Panel) illuminate any time the system is in the Coarse Align Mode, IMU Cage, or during Turn On.
- 5.13.2 Tracker Fail lamp may light after optics power turn on. Press the Error Reset to extinguish.
- 5.13.3 The CMC warning light may come on for approximately 10 seconds when +28 VDC CMC Operate Power is applied; if the MASTER ALARM light illuminates, push to reset.
- 5.13.4 When coming out of AGC STBY, if the Standby lamp does not extinguish when the STBY pushbutton is pressed, repeatedly press the STBY pushbutton until the Standby lamp does extinguish. Record the number of times it was necessary to press the STBY pushbutton.

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6.2.1.5 IMU HTR Heater Power On

6.2.1.5.1 Enter the IMU Standby Mode of operation by engaging the IMU HTR MNA and MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).

6.2.1.5.2 Verify that the IMU +28 VDC STANDBY discrete lamp on Event Module is illuminated (CG 1513). On DSKY verify TEMP light is extinguished. On the G&N Indicator Control Panel verify PGNS light is extinguished.

6.2.1.5.3 Record the value of the following signals displayed on the CRT.

Signal	Requirement
a. CG 1331 28V 3200 CPS POWER SUPPLY FEEDBACK	28.6±0.6 VRMS
b. CG 1510 + 28 VDC STANDBY POWER	28.8 (±3) VDC

6.2.1.5.4 30 minutes after entering the IMU Standby Mode start recording PIPA TEMP every 5 minutes until the PIPA temperature is stabilized. The PIPA temperature shall be considered stabilized when the temperature change is not more than 0.1 deg for 30 minutes. Record the PIPA Standby Mode stabilized temperature. The recorded temperature shall be 130.5±1.5 degrees.

6.2.1.5.5 Deleted

6.2.1.5.6 On the Event Recorder, verify that the IMU HEATER Current discrete (CG 2302) is ON and that the IMU BLOWER Current discrete (CG 2303) is OFF over the PIPA Standby Temperature stabilization period (occasionally discrete may cycle.)

6.2.1.5.7 With the eyepiece in the Eyepiece Storage Unit, check the eyepiece surface temperature at the quick disconnect flange using an L&N #8693 Temperature Potentiometer, or a similar type thermocouple probe meter. Record both the ambient and eyepiece surface temperatures and verify that the eyepiece surface temperature is at least 10°F above the ambient temperature.

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- 6.2.2.4.8 Enter the following sequence into the LEB CMC DSKY to check the proceed interface of the PRO pushbutton.
- a) VERB 11 NOUN 10, ENTER
 - b) 00032, ENTER
- Verify R1 = 7XXXX. Press and hold the PRO pushbutton and verify 5XXXX displayed in R1. Release the PRO pushbutton once and verify that "5XXXX" is displayed. Release the PRO pushbutton and verify 7XXXX displayed in R1. Enter VERB 34 and press the ENTER pushbutton.
- 6.2.2.4.9 Repeat of 6.2.2.4.1 through 6.2.2.4.8, using the MDC CMC DSKY.
The results shall be as specified in 6.2.2.4.4.
- 6.2.2.5 Uplink and Downlink Checks.
- 6.2.2.5.1 Enter VERB 36 into K148. Press the ENTER pushbutton, then press ERROR RESET pushbutton.
- 6.2.2.5.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.
- a. VERB 25 NOUN 01 ENTER
 - b. 01000, ENTER
 - c. 00000, ENTER
 - d. 77777, ENTER
 - e. 07254, ENTER
 - f. VERB 05 NOUN 01, ENTER
 - g. 01000, ENTER
- 6.2.2.5.3 CMC Registers R1, R2, and R3 display on the CRT shall indicate 00000, 77777, and 07254, respectively.
- 6.2.2.5.4 Set/verify that the UP TLM switch on the Main Display Panel is set to ACCEPT and that the UP TLM switch on the G&N Control Panel is set to BLOCK.
- Verify that the BLOCK UPLINK discrete is ON, CRT is ON.
- 6.2.2.5.5 Execute the Block Uplink Override R-START to enable data to be sent via K-START. On K-148 insert VERB. Verify that the VERB indication on the DSKY and CRT does not change, on the DSKY and CRT does not change.
- 6.2.2.5.6 Set the UP TLM switch on the G&N Indicator Control Panel to ACCEPT. Verify that the BLOCK UPLINK discrete is OFF, CRT is OFF.
- 6.2.2.5.7 On K-148 insert VERB 01. Verify that the VERB indication on the DSKY and CRT is 01.

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6.2.2.6 Parity Fail Test.

6.2.2.6.1 Enter the following into the K-Start. Press the ENTER pushbutton after each entry.

- a. VERB 24, NOUN 01, ENTER
- b. 01600, ENTER
- c. 33777, ENTER
- d. 04353 ENTER
- e. VERB 25 NOUN 26, ENTER
- f. 04000, ENTER
- g. 01600, ENTER
- h. 00003, ENTER
- i. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.6.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.6.3 Enter VERB 36, into the K-START. Press the ENTER pushbutton.

- 6.2.3.1.7 Insure that the following alarm lamps are not lighted on G&N LEB Display Panel.
- a. CMC Warning
 - b. ISS Warning
 - c. PGNS Caution
- 6.2.3.1.8 Verify that the PROGRAM ALARM lamp on the DSKY's does not light with VERB 05 NOUN 31 and R1 = 00213 displayed.
- 6.2.3.1.9 The OG, IG, and MG CDU angles shall be 00000±00150. Verify on CRT.
- 6.2.3.1.10 Enter the following into K-148:
- a. VERB 41 NOUN 20, ENTER
 - b. +00000, ENTER
 - c. +00000, ENTER
 - d. +00000, ENTER
- 6.2.3.1.11 Verify that the following secondary power supply voltages are not flashing on the CRT display.

Table VI. Secondary Power Supply Voltages

Mess. No.	Signal
1 CG 1040	+120 VDC PIPA SUPPLY
2 CG 1051	+20 VDC PIPA SUPPLY
3 CG 1052	-20 VDC PIPA SUPPLY
4 CG 1070	+4 VDC CDU SUPPLY
5 CG 1100	-28 VDC ELECTRONICS
6 CG 1020	+14 VDC CMC SUPPLY
7 CG 1030	+4 VDC CMC SUPPLY
8 CG 1201	IMU 28V 800 CPS 1 pct 0 ph
9 CG 1202	IMU 28V 800 CPS 5 pct ph A
10 CG 1203	IMU 28V 800 CPS 5 pct ph B
11 CG 1331	3.2KC 28V SUPPLY
12 CG 1110	2.5 VDC TM BIAS

- 6.2.3.1.12 Monitor the PIPA temperature during the first 15 minutes after switching from Standby Mode to the Operate Mode. The PIPA temperature shall be 130.5±2.0 deg. F. during this period. 15 minutes after switching from Standby Mode to the Operate Mode, record the PIPA temperature. The recorded PIPA temperature shall be within 0.5 deg. F. of the Operate stabilized PIPA temperature determined below.
- 6.2.3.1.13 Deleted
- 6.2.3.1.14 30 minutes after entering the IMU Operate Mode, start recording PIPA TEMP every 5 minutes until the PIPA temperature is stabilized. The PIPA temperature shall be considered stabilized when the temperature change is not more than 0.1 deg for 30 minutes. Record the PIPA Operate Mode stabilized temperature. The PIPA Operate Mode stabilized temperature shall be 130.5±1.5 deg. F. and within 1.0 deg. F. of stabilized PIPA temperature.
- 6.2.3.1.15 Deleted

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6.2.4.5 Record the voltage indicated on the CRT for the following power supplies:

- a. The +120 VDC PIPA Power Supply output voltage shall be 120 ± 6 VDC (CG 1040).
- b. The +20 VDC PIPA Power Supply output voltage shall be 20.0 ± 1.2 VDC (CG 1051).
- c. The -20 VDC PIPA Power Supply output voltage shall be -20 ± 2 VDC (CG 1052).
- d. The -28 VDC Electronics Power Supply output voltage shall be -28.5 ± 6.0 VDC (CG 1100).

6.2.4.6 The following values shall be measured with the guidance reference clock synchronizing input pulse. Record the voltage indicated on the CRT.

- a. IMU 28V, 800 CPS 1° 0 deg. voltage shall be 28.0 ± 0.6 VAC (CG 1201).
- b. IMU 28V, 800 CPS, 5° PHA - 90 deg. voltage shall be 28.0 ± 1.4 VAC (CG 1202).
- c. IMU 28V, 800 CPS, 5° PHB 0 deg. voltage shall be 28.0 ± 2.1 VAC (CG 1203).
- d. Optics 28V, 800 CPS 1° 0 deg. voltage shall be 28.0 ± 0.6 VAC (CG 1211).
- e. Optics 28V, 800 CPS 5° - 90 deg. voltage shall be 28.0 ± 1.5 VAC (CG 1212).
- f. PH Diff IMU 5° 0 deg. -90 deg. (CG 1207) phase difference shall be -90° $\pm 10^\circ$.
- g. Ph Diff Optics 1° IMU 1° (CG1220) phase difference shall be $0^\circ \pm 10^\circ$.

6.2.4.7 Record the voltages indicated on the CRT for the following power supplies:

- a. The +14 VDC CMC Power Supply output voltage shall be $+14.0 \pm 0.4$ VDC (CG 1020).
- b. The +4 VDC CMC Power Supply output voltage shall be $+4.0 \pm 0.2$ VDC (CG 1030).
- c. The +4 VDC CDU Power Supply output voltage shall be $+4.0 \pm 0.2$ VDC (CG 1070).
- d. The +2.5 VDC TM BIAS SUPPLY output voltage shall be $+2.50 \pm 0.05$ VDC (CG 1110).

6.2.4.8 Record the CRT indications for the following measurements:

- a. The 28V, 3200 CPS Power Supply feedback output voltage shall be 28.6 ± 0.6 VRMS (CG 1331).
- b. The phase difference between the 3.2Kc supply and CMC sync shall be $0^\circ \pm 10^\circ$ (CG 1335).
- c. The +14 VDC CMC power Supply RMS noise shall be less than 0.2 VRMS (CG 1331).
- d. The +4 VDC CMC Power Supply rms noise shall be less than 0.2 VRMS (CG 1331).

6.2.5.2.8.4 Enter the following in K-148 to turn on the Computer Activity Light.

a. VERB 34	ENTR
b. VERB 21 NOUN 27	ENTR
c. 00000	ENTR
d. VERB 25 NOUN 01	ENTR
e. 03770	ENTR SET LOC
f. 10067	ENTR CCS NEW JOB
g. 04317	ENTR TC CHANG1
h. 01770	ENTR TC ACTLITON
i. VERB 25 NOUN 26	ENTR CALL PRIO/DELAY
j. 01000	ENTR 01 PRIORITY
k. 01770	ENTR RELATIVE E-MEM
m. 00007	ENTR BANKADD
n. VERB 30	ENTR REQ EXEC

NOTE: If a VERB 36 is performed after the above information has been entered repeat lines 6.2.5.2.8.4.1 through 6.2.5.2.8.4.n. An exception is the VERB 36 performed when entering Voltage Margin Test (6.2.19). After completing Voltage Margin Test, repeat lines 6.2.5.2.8.4.1 through 6.2.5.2.8.4.n.

NOTE: Allow 2 hours to elapse before proceeding to 6.2.5.2.9 with the following exceptions:

- a. If the G&N System has been in the power off state for less than 5 days with the gimbals in the parked position (0°, 0°, 90°) and the system has not been moved, allow 15 minutes to elapse before proceeding.
- b. If the G&N System has been turned off with the gimbals in the unparked position for less than 2 hours allow a warmup time equal to the time off but not less than 15 minutes to elapse before proceeding.

CAUTION: If the requirements of 6.2.5.2.10 are not met, remove IMU Operate Power immediately by setting the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

6.2.5.2.9 After the required warmup time has elapsed set the G&N IMU MN A and MN B circuit breaker on the Right Hand circuit breaker panel to ON (breaker pushed in) and the G/N POWER-IMU switch on the LEB Lighting Control Panel to the ON position (toggle-up).

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- 6.2.7.4.8 Enter the following sequence in the K-Start:
- a. VERB 42, press ENTR
 - b. VERB 33, press ENTR (Verify VERB 33 on CRT)
- 6.2.7.4.9 Start analog recorders.
- 6.2.7.4.10 Observe measurement CG 2142, MG 1X Resolver output SIN, on the analog recorder. When the steady-state condition occurs (approximately 5 minutes), stop the recorders.
- 6.2.7.4.11 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.
- a. VERB 36, ENTER
 - b. VERB 40 NOUN 20, press ENTER
 - c. VERB 41, NOUN 20, press ENTER
 - d. +00000, press ENTER
 - e. +00000, press ENTER
 - f. +00000, press ENTER
- 6.2.7.5 Examine the traces of the recorded measurements for all six phases of this test to detect any sharp discontinuities. Disregard transients. The Gimbal Torque motor currents shall not exceed 0.125 amperes. The CDU Fine Error measurements shall not exceed ± 70 mv rms. The CDU Coarse Error measurement shall not exceed ± 600 mv rms. The CDU Coarse Error measurement shall not exceed ± 600 mv rms. The CDU Coarse Error measurement shall not exceed ± 600 mv rms.

- 6.2.12.6.5 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO.
- 6.2.12.6.6 Set the OPTICS TEL TRUN switch to SLAVE to SXT position.
- 6.2.12.6.7 Remove the plug from the base of the SXT eyepiece and install the Adapter Assembly and Portable Light Assembly. Turn on the light.
- NOTE: If needed to reduce external light, place a photographer's hood over the optics head and retroreflecting prism.
- 6.2.12.6.8 Sight through the SCT eyepiece and provide direction to personnel outside spacecraft for positioning the Retroreflecting Prism, Model No. A23-200, to span between the SXT LLOS and SCT LOS such that the illumination from the back-light filament is clearly visible at the center of the field of view. Prism must be held in this alignment position until completion of Step 6.2.12.6.11.
- 6.2.12.6.9 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Note the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement, expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. For instance, the outer ends of the SXT reticle lines are 6% from center. Displacement shall be less than 50% (bar must be closer to center than to edge of field of view).
- 6.2.12.6.10 Set the OPTICS TEL TRUN switch to 0° position.
- 6.2.12.6.11 Again direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in Step 6.2.12.6.9. Place the OPTICS MODE switch to MAN and observe the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. Displacement shall be less than 50%.
- 6.2.12.6.12 Remove the Retroreflecting Prism.
- 6.2.12.6.13 Replace the Portable Light in the adapter on the SXT eyepiece.
- 6.2.12.6.14 While sighting into the SCT eyepiece, set the OPTICS TEL TRUN switch to 25 deg. and observe that the resolution pattern mounted outside the spacecraft appears to move downward from the center of the field of view to the zero reticle marking that is 25 deg. below the center of the field of view.
- 6.2.12.6.15 Record the TPAC Trunnion Angle. It shall be $25.00^\circ \pm 1.0^\circ$.

6.2.13.10 Perform the following calculations:

- a. Difference between R1 displays = ____ (Δ shaft angle)
- b. Difference between R3 displays = ____ (Δ time)
- c. $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{____ deg/sec}$

The Shaft Slew Rate shall be $19.5 \pm 3.9 \text{ deg/sec}$
TRUNNION SLEW RATE - MED SPEED

6.2.13.11 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Set the OPTICS SPEED switch to MED. Monitor MARK command by entering VERB 06 NOUN 56 in K146. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.12 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

6.2.13.12 Record the SXT TRUN MTR control winding (CG 3155), SXT TRUN SERVO error (CG 3118) and SXT TRUN TACH (CG 3150) signals on the CRT while slewing the optics. CG 3155 and CG 3118 shall be +0.25 to +2.00 VRMS, and CG 3150 shall be +0.23±0.12 VRMS. Push and hold the Optics Control Stick to its upper limit. Approximately 3 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R2 = +XX.XXX (Trunnion LOS angle in deg)
- b. R3 = +XXX.XX (Time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.13 Perform the following calculations:

- a. Difference between R2 displays = ____ (Δ trunnion angle)
- b. Difference between R3 displays = ____ (Δ time)
- c. $\frac{\Delta \text{trunnion angle}}{\Delta \text{time}} = \text{____ deg/sec}$

The Trunnion Slew Rate shall be $1.0 \pm 0.2 \text{ deg/sec}$.

SHAFT SLEW RATE - MED SPEED

6.2.13.14

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to MAN. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.15 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.15

Record the SXT SHAFT MTR control winding (CG 3145), SXT SHAFT SERVO error (CG 3117), and SXT SHAFT TACH (CG 3140) signals on the CRT while slewing the optics. CG 3145 and CG 3117 shall be +0.50 to +4.00 VRMS, and CG 3140 shall be 0.33 ± 0.13 VRMS. Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R1 = +XXX.XX (Shaft angles in deg)
- b. R3 = +XXX.XX (Time in seconds)

After the display has changed, again record the values of R1 and R3.

6.2.13.16

Perform the following calculations:

- a. Difference between R1 displays = ____ (Δ shaft angle)
- b. Difference between R3 displays = ____ (Δ time)
- c. $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{____ deg/sec}$

The Shaft Slew Rate shall be 2.0 ± 0.4 deg/sec.

TRUNNION SLEW RATE - LO SPEED

6.2.13.17

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Set the OPTICS SPEED switch to LO. Monitor MARK command by entering the VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.18 before proceeding. Do not hold control stick at upper limit for more than 30 seconds.

6.2.13.18

Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 sec (before display changes). The data displayed is in the following form:

OPTICS HAND CONTROLLER DRIFT RATE CHECK - LO SPEED

- 6.2.13.23 On K-148, enter VERB 06 NOUN 56 ENTER. Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF.
- 6.2.13.24 Press and release MARK pushbutton. Approximately 60 seconds after the first MARK, again press and release MARK pushbutton. Verify KEY RELEASE is flashing. Press KEY RELEASE pushbutton and record data in R1, R2 and R3 within 2 seconds. When DSKY display changes, again record R1, R2 and R3. The data display is in the following form:
- a. R1 = +XXX.XX (Shaft Angle in Degrees)
 - b. R2 = +XX.XXX (Trunnion Angle in Degrees)
 - c. R3 = +XXX.XX (Time in Seconds)
- 6.2.13.25 Perform the following calculations (first display minus second display):
- a. Difference between R1 displays = _____ (Δ shaft angle)
 - b. Difference between R2 displays = _____ (Δ trunnion angles)
 - c. Difference between R3 displays = _____ (Δ time)
 - d. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \text{_____ deg/sec (shaft drift rate)}$
shall be less than 0.0333 deg/sec.
 - e. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}} = \text{_____ deg/sec (trunnion drift rate)}$
shall be less than 0.0167 deg/sec.
- 6.2.13.26 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

- 6.2.18.8.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the SXT. Slew OPTICS to ZERO.
- 6.2.18.9 Gyrocompassing Stability
- 6.2.18.9.1 Enter VERB 33; ENTER into the DSKY. On the DSKY observe the PROGRAM display change to 05 after approximately 90 seconds. Approximately 5 minutes later observe the PROGRAM display change to 02. When PROG display changes to 02 record time as T_0 .
- 6.2.18.9.2 120 minutes after T_0 record the Outer, Inner and Middle CDU Gimbal angles from the CRT.
- 6.2.18.9.3 Repeat above step every 5 minutes for the next 60 minutes.
- 6.2.18.9.4 The peak-to-peak spread of the outer gimbal angle shall not exceed 0.12 degrees.
- 6.2.18.9.5 The peak-to-peak spread of the Inner and Middle gimbal angles shall not exceed 0.06 degrees.
- 6.2.18.10 Gyrocompassing Accuracy
- 6.2.18.10.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Between 175 minutes and 180 minutes from T_0 set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.10.2 Enter the following into the DSKY.
- a. VERB 21 NOUN 03 ENTER
 - b. 02663 ENTER
 - c. +XXX.XX±000.01 ENTER (Target No. 1 Az)
 - d. Press ENTER Pushbutton
 - e. 02664 ENTER
 - f. +XXX.XX±000.01 ENTER (Target No. 2 Az)
 - g. Press ENTER Pushbutton
 - h. 02665 ENTER
 - i. +00.000 ENTER (Target No. 1 EL)
 - j. Press ENTER Pushbutton
 - k. 02666 ENTER
 - l. +00.000 ENTER (Target No. 2 EL)
- On the G&N Indicator Control Panel set the OPTICS ZERO switch to OFF, set the OPTICS MODE switch to MAN and the OPTICS SPEED switch to HI. Drive the StLOS to the approximate position of Target No. 1. Set the OPTICS SPEED Switch to LO.
- NOTE: Read the following 10 steps before proceeding. These are time critical steps and must be performed as rapidly as possible.
- 6.2.18.11 After 180 minutes from T_0 enter VERB 53 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT change to 03.

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6.2.18.26.2 Perform the following calculations. (Cos λ functions are provided in Table I.)

a. $D_{(vert)} = NBDZ + ADIAZ$

$D_{(vert)} = () \text{ } \underline{\hspace{2cm}} \text{ meru}$

b. $D_{(east)} = \sin (\text{Launch Az}) NBDX + \cos (\text{Launch Az}) NBDY + ADGRAY$

c. $\phi_{(vert)} = \frac{D_{(vert)} \times \frac{12.8}{3600} + D_{(east)} \times \frac{206}{\cos \lambda}}{\cos \lambda}$

$\phi_{(vert)} = () \text{ } \underline{\hspace{2cm}} \text{ degrees}$

Table I

Location	Latitude λ	Cos λ
NAA	33.921	0.82965
MTLA	28.516	0.87668
MSC	29.556	0.86993

6.2.18.26.3 Perform the following calculations using the recorded data from 6.2.18.25 and 6.2.18.26.2.

a. Z Gyro azimuth error 3 hrs (corrected) = line 3 - $\phi_{(vert)}$
Z Gyro azimuth error 3 hrs (corrected) = $\underline{\hspace{2cm}}$ corrected
Z Gyro azimuth error (corrected) shall be 0.00 \pm 0.573 degrees.

b. X Gyro elevation error (3 hr) = line 1 $\underline{\hspace{2cm}}$
X Gyro elevation error (3 hr) = $\underline{\hspace{2cm}}$ degrees

c. Y Gyro elevation error (3 hr) = line 2 $\underline{\hspace{2cm}}$
Y Gyro elevation error (3 hr) = $\underline{\hspace{2cm}}$ degrees
The X and Y Gyro elevation errors shall be 0.00 \pm 0.045 degrees.

6.2.19 CMC Voltage Margin Test

6.2.19.1 Verify that the G&N IMU HTR MNA and MNB breakers are engaged, computer MNA and MNB breakers are engaged, IMU MNA and MNB breakers are not engaged, and the G&N Power-IMU switch on the LEB Lighting Control Panel is in the OFF position. On K-148, enter VERB 36 ENTR.

6.2.19.2 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to ON.

CAUTION: During the performance of this test the +4 VDC CMC Power Supply shall not be operated at less than +2.5 VDC or greater than 5.2 VDC (CG 1030). The +14 VDC CMC Power Supply shall not be operated at less than +8.5 VDC or greater than +17.0 VDC (CG 1020). Rotate the LEB LTS NUMERICS SEL to approximately center position. Decrease to absolute minimum

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6.2.19.2 discernible lighting.
(cont)

NOTE: The flashing indication of the CMC Power Supplies on CRT may be disregarded for this test. The charts in Table I may be used to determine approximate values for the "XX.X" values of C-156 voltage dial settings corresponding to various power supply voltages.

6.2.19.2.1 Into R-153, insert 1100. Verify and execute.

6.2.19.3 Units R-154, insert 0001. Verify and execute.

6.2.19.4 Insert in C-156, -040001244 and execute. Verify on CRT that GV0116 is between -3.0 and -5.0 vdc.

6.2.19.5 Insert in C-156 -050001234 and execute. Verify on CRT that GV0106 is between -4.0 and -6.0 vdc.

6.2.19.6 Units R-154, insert 0111. Verify and execute.

6.2.19.7 Observe CG 1020, +14 VDC Power Supply, and CG 1030, +4 VDC Power Supply on CRT. Repeat 6.2.19.3 through 6.2.19.6 adjusting each C Start entry until CG 1020 is 12.1, +0.1, -0.0 vdc and CG 1030 is 3.40, +0.03, -0.00 vdc.

6.2.19.8 Initiate CMC Self Check by inserting the following in K-148.

- a. ERROR RESET
- b. VERB 21, NOUN 27, ENTER
- c. 77777, ENTER

Wait 200 seconds.

6.2.19.9 Insure that the DSKY RESTART lamp does not light, and that

- a. VERB 05 NOUN 31
 - b. R1 = 01103
- does not appear on DSKY.

6.2.19.9.1 Into R-154, insert 0101. Verify and execute.

6.2.19.10 Set INHIBIT VOLTAGE FAIL switch to OFF on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. If RESTART lamp does not light, repeat 6.2.19.3. Verify CMC Warning master alarms are lighted.

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- 6.2.19.11 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- a. ERROR RESET
 - b. VERB 21, NOUN 27, ENTER
 - c. 77777, ENTER
- 6.2.19.12 Units R-154, insert 0001. Verify and execute.
- 6.2.19.13 Insert in C-154 +108001244 and execute. Verify on CRT that GV0116 is between +0.8 and +11.8 vdc.
- 6.2.19.14 Units R-154, insert 0111. Verify and execute.
- 6.2.19.15 Observe CG 1020, +14 VDC Power Supply on CRT. Repeat 6.2.19.12 through 6.2.19.14 adjusting the C Start entry until CG 1020 is 16.4, +0.0, -0.1 vdc.
- 6.2.19.16 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- a. VERB 06, NOUN 31
 - b. R1 = 01102
- does not appear on DSKY.
- 6.2.19.16.1 Into R-154, insert 0011. Verify and execute.
- 6.2.19.17 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted.
- 6.2.19.18 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- a. ERROR RESET
 - b. VERB 21, NOUN 27, ENTER
 - c. 77777, ENTER
- 6.2.19.19 Units R-154, insert 0001. Verify and execute.
- 6.2.19.20 Insert in C-154, +092001234 and execute. Verify on CRT that GV0106 is between +6.2 and +10.2 vdc.
- 6.2.19.21 Units R-154, insert 0111. Verify and execute.
- 6.2.19.22 Observe CG 1030, +4 VDC Power Supply on CRT. Repeat 6.2.19.19 through 6.2.19.21 adjusting the C Start entry until CG 1030 is 4.60, +0.00, -0.03 vdc.
- 6.2.19.23 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- a. VERB 06, NOUN 31
 - b. R1=01102
- does not appear on DSKY.
- 6.2.19.23.1 Into R-154, insert 0101. Verify and execute.

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- 6.2.19.24 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted. ~~Verify that CG 1020 is at PSAAM interface instead of CRT.~~
- 6.2.19.25 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- ERROR RESET
 - VERB 21, NOUN 27, ENTER
 - 77777, ENTER.
- 6.2.19.26 Units R-154, insert 0001. Verify and execute:
- 6.2.19.27 Insert in C-156, -040001244 and execute. Verify on CRT that GV0116 is between -3.0 and -5.0 vdc.
- 6.2.19.28 Units R-154, insert 0111. Verify and execute.
- 6.2.19.29 Observe CG 1020, +14 VDC Power Supply on CRT. Repeat 6.2.19.26 through 6.2.19.28 adjusting the C Start entry until CG 1020 is 12.1, +0.1, -0.0 vdc.
- 6.2.19.30 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- VERB 06, NOUN 31
 - R1 = 01102
- does not appear on DSKY.
- 6.2.19.30.1 Into R-154, insert 0011. Verify and execute.
- 6.2.19.31 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted. ~~Verify that CG 1020 is at PSAAM interface instead of CRT.~~
- 6.2.19.32 Units R-154, insert 0000. Verify and execute.
- 6.2.19.33 Terminate CMC Self-Check by inserting into K-148:
- ERROR RESET
 - VERB 21, NOUN 27, ENTER
 - 00000, ENTER
- 6.2.19.34 Ensure that CG 1020, +14 VDC Power Supply indication is +14.0, +0.4, and that CG 1030, +4 VDC Power Supply indication is +4.00+0.20 VDC on CRT.

TRUNNION SLEW RATE - MED SPEED

6.2.13.11

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to MED. Monitor MARK command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.12 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

6.2.13.12

Record the SXT TRUN MTR control winding (CG 3155) SXT TRUN SERVO error (CG 3118) and SXT TRUN TACH (CG 3150) signals on the CRT while slewing the optics. CG 3155 and CG 3118 shall be +0.25 to +2.00 VRMS, and CG 3150 shall be +0.33 ± 0.13 VRMS. Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R2 = ±XX.XXX (trunnion LOS angle in deg)
- b. R3 = ±XXX.XX (time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.13

Perform the following calculations:

- a. Difference between R2 displays = _____. (Δ trunnion angle)
- b. Difference between R3 displays = _____. (Δ time)
- c. $\frac{\Delta \text{trunnion angle}}{\Delta \text{time}} = \text{_____ deg/sec}$

The Trunnion Slew Rate shall be 1.0 ± 0.2 deg/sec.

SHAFT SLEW RATE - MED SPEED

6.2.13.14

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS Mode switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.15 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.15

Record the SXT SHAFT MTR control winding (CG 3145), SXT SHAFT SERVO error (CG 3117), and SXT SHAFT TACH (CG 3140) signals on the CRT while slewing the optics. CG 3145 and CG 3117 shall be +0.50 to +4.00 VRMS, and CG 3140 shall be 0.33±0.18 VRMS. Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R1 = +XXX.XX (shaft angle in deg)
- b. R3 = +XXX.XX (time in seconds)

After display has changed, again record the values of R1 and R3.

6.2.13.16

Perform the following calculations:

- a. Difference between R1 displays = ____ · ____ (Δ shaft angle)
- b. Difference between R3 displays = ____ · ____ (Δ time)
- c. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \text{__} \cdot \text{__} \text{ deg/sec}$

The Shaft Slew Rate shall be 2.0±0.4 deg/sec.

TRUNNION SLEW RATE - LO SPEED

6.2.13.17

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the Controller SPEED switch to LO. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

6.2.13.17.1

During the Trunnion Slew Rate Test-Lo Speed, monitor and verify the following signal on the CRT.

- a. TRUNNION CDU FINE ERROR (CG 3011 Link 2) ±.07 VRMS MAX

NOTE: Read and understand 6.2.13.18 before proceeding. Do not hold control stick at upper limit for more than 30 seconds.

6.2.13.18

Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R2 = +XX.XXX (trunnion LOS angle in deg)
- b. R3 = +XXX.XX (time in seconds)

After the display has changed, again record the values of R2 and R3.

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POST INSTALLATION CHECKOUT PROCESS
SPECIFICATION FOR THE APOLLO GUIDANCE
AND NAVIGATION SYSTEM - BLOCK II

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
12/21/67	G	35343	26, 33, 48, 50, 54	EA <i>SH/AC</i>	—
2/28/68	H	35700	3, 4, 8, 11-13, 17, 21, 23, 25-27, 30-33, 38, 40-42, 47-51, 54, 61	EA	WLS
			62, 69-134: was 134 pages, now 158 pages. <i>SH/AC</i>		
4/4/68	J	36039	6, 68-71, 73-84, 106, 113, 115, 130, 133-158; was 158 pages, now 157 pages; total no. pages 158. <i>RNR/AC</i>	EA	RJJ
4/18/68	K	36109	10, 15, 27, 31, 33, 42, 45, 51, 62, 76, 81, 82, 84, 113, 117-120, 149, 150, 152, 27, 42, 48-50, 53-157 was 157 pages, now 162 pages. <i>SH/AC</i>	EA	WLS
7/25/68	L	36575		EA: I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, AA, AB, AC, AD, AE, AF, AG, AH, AI, AJ, AK, AL, AM, AN, AO, AP, AQ, AR, AS, AT, AU, AV, AW, AX, AY, AZ, BA, BB, BC, BD, BE, BF, BG, BH, BI, BJ, BK, BL, BM, BN, BO, BP, BQ, BR, BS, BT, BU, BV, BW, BX, BY, BZ, CA, CB, CC, CD, CE, CF, CG, CH, CI, CJ, CK, CL, CM, CN, CO, CP, CQ, CR, CS, CT, CU, CV, CW, CX, CY, CZ, DA, DB, DC, DD, DE, DF, DG, DH, DI, DJ, DK, DL, DM, DN, DO, DP, DQ, DR, DS, DT, DU, DV, DW, DX, DY, DZ, EA, EB, EC, ED, EE, EF, EG, EH, EI, EJ, EK, EL, EM, EN, EO, EP, EQ, ER, ES, ET, EU, EV, EW, EX, EY, EZ, FA, FB, FC, FD, FE, FF, FG, FH, FI, FJ, FK, FL, FM, FN, FO, FP, FQ, FR, FS, FT, FU, FV, FW, FX, FY, FZ, GA, GB, GC, GD, GE, GF, GG, GH, GI, GJ, GK, GL, GM, GN, GO, GP, GQ, GR, GS, GT, GU, GV, GW, GX, GY, GZ, HA, HB, HC, HD, HE, HF, HG, HH, HI, HJ, HK, HL, HM, HN, HO, HP, HQ, HR, HS, HT, HU, HV, HW, HX, HY, HZ, IA, IB, IC, ID, IE, IF, IG, IH, II, IJ, IK, IL, IM, IN, IO, IP, IQ, IR, IS, IT, IU, IV, IW, IX, IY, IZ, JA, JB, JC, JD, JE, JF, JG, JH, JI, JJ, JK, JL, JM, JN, JO, JP, JQ, JR, JS, JT, JU, JV, JW, JX, JY, JZ, KA, KB, KC, KD, KE, KF, KG, KH, KI, KJ, KK, KL, KM, KN, KO, KP, KQ, KR, KS, KT, KU, KV, KW, KX, KY, KZ, LA, LB, LC, LD, LE, LF, LG, LH, LI, LJ, LK, LL, LM, LN, LO, LP, LQ, LR, LS, LT, LU, LV, LW, LX, LY, LZ, MA, MB, MC, MD, ME, MF, MG, MH, MI, MJ, MK, ML, MM, MN, MO, MP, MQ, MR, MS, MT, MU, MV, MW, MX, MY, MZ, NA, NB, NC, ND, NE, NF, NG, NH, NI, NJ, NK, NL, NM, NN, NO, NP, NQ, NR, NS, NT, NU, NV, NW, NX, NY, NZ, OA, OB, OC, OD, OE, OF, OG, OH, OI, OJ, OK, OL, OM, ON, OO, OP, OQ, OR, OS, OT, OU, OV, OW, OX, OY, OZ, PA, PB, PC, PD, PE, PF, PG, PH, PI, PJ, PK, PL, PM, PN, PO, PP, PQ, PR, PS, PT, PU, PV, PW, PX, PY, PZ, QA, QB, QC, QD, QE, QF, QG, QH, QI, QJ, QK, QL, QM, QN, QO, QP, QQ, QR, QS, QT, QU, QV, QW, QX, QY, QZ, RA, RB, RC, RD, RE, RF, RG, RH, RI, RJ, RK, RL, RM, RN, RO, RP, RQ, RR, RS, RT, RU, RV, RW, RX, RY, RZ, SA, SB, SC, SD, SE, SF, SG, SH, SI, SJ, SK, SL, SM, SN, SO, SP, SQ, SR, SS, ST, SU, SV, SW, SX, SY, SZ, TA, TB, TC, TD, TE, TF, TG, TH, TI, TJ, TK, TL, TM, TN, TO, TP, TQ, TR, TS, TT, TU, TV, TW, TX, TY, TZ, UA, UB, UC, UD, UE, UF, UG, UH, UI, UJ, UK, UL, UM, UN, UO, UP, UQ, UR, US, UT, UY, UZ, VA, VB, VC, VD, VE, VF, VG, VH, VI, VJ, VK, VL, VM, VN, VO, VP, VQ, VR, VS, VT, VU, VV, VW, VX, VY, VZ, WA, WB, WC, WD, WE, WF, WG, WH, WI, WJ, WK, WL, WM, WN, WO, WP, WQ, WR, WS, WT, WU, WV, WW, WX, WY, WZ, XA, XB, XC, XD, XE, XF, XG, XH, XI, XJ, XK, XL, XM, XN, XO, XP, XQ, XR, XS, XT, XU, XV, XW, XX, XY, XZ, YA, YB, YC, YD, YE, YF, YG, YH, YI, YJ, YK, YL, YM, YN, YO, YP, YQ, YR, YS, YT, YU, YV, YW, YX, YY, YZ, ZA, ZB, ZC, ZD, ZE, ZF, ZG, ZH, ZI, ZJ, ZK, ZL, ZM, ZN, ZO, ZP, ZQ, ZR, ZS, ZT, ZU, ZV, ZW, ZX, ZY, ZZ	

This specification consists of pages I to 162 including Appendix I, pages 157-158, Addendum I, pages 159-160, Addendum II, pages 160-161 and Addendum III, page 162.

APPROVALS	Not required per CCA-497-0274 NASA/MS	MIT/IL	R. D. Petryk	D. A. Ziemer
			AC	

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- 5.10 The test equipment listed in paragraph 4.1 shall be connected and ready for operation before the tests of this specification are initiated.
- 5.11 Data Records
- 5.11.1 All data concerning the checkout and operation of the G&N System as monitored via ACE, shall be recorded on the data sheets associated with their corresponding test. Out of tolerance readings shall be recorded and flagged by appropriate symbols.
- 5.11.1.1 All test data obtained while demonstrating the requirements of this document shall be permanently recorded and forwarded with the tested G&N to the next receiving agency.
- 5.11.1.2 A record of the amount of time each of the four prime power busses are on shall be kept and forwarded with the G&N to the next receiving agency.
- 5.12 Interface
- 5.12.1 The APOLLO G&N System shall interface with accepted ECS and EPS distribution systems for power and environment control purposes and with the SCS or SCS substitute system for signal interface in accordance with the applicable ICD's.
- 5.13 General System Operating Characteristics
- 5.13.1 The DSKY "NO ATT" lamp and PGNS light (GNIC Panel) illuminate any time the system is in the Coarse Align Mode, IMU Cage, or during Turn On.
- 5.13.2 Tracker Fail lamp may light after optics power turn on. Press the Error Reset to extinguish.
- 5.13.3 The CMC warning light may come on for approximately 10 seconds when +28 VDC CMC Operate Power is applied; if the MASTER ALARM light illuminates, push to reset.
- 5.13.4 When coming out of AGC Standby, if the STBY lamp does not extinguish when the PRO pushbutton is pressed, repeatedly press the PRO pushbutton until the STBY lamp does extinguish. Record the number of times it was necessary to press the PRO pushbutton. No more than three depressions of the PRO pushbutton shall be required to turn the STBY lamp off.

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6.2.1.5 IMU HTR Heater Power On

6.2.1.5.1 Enter the IMU Standby Mode of operation by engaging the IMU HTR MN A and MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).

6.2.1.5.2 Verify that the IMU +28 VDC STANDBY discrete lamp on Event Module is illuminated (CG 1513). On DSKY verify TEMP light is extinguished. On the G&N Indicator Control Panel verify PGNS light is extinguished.

6.2.1.5.3 Record the value of the following signals displayed on the CRT.

Signal	Requirement
a. CG 1331 28V 3200 CPS POWER SUPPLY FEEDBACK	28.6±0.6 VRMS
b. CG 1510 + 28 VDC STANDBY POWER	28.8 (±3) VDC

6.2.1.5.4 30 minutes after entering the IMU Standby Mode start recording PIPA TEMP every 5 minutes until the PIPA temperature is stabilized. The PIPA temperature shall be considered stabilized when the temperature change is not more than 0.1 deg for 30 minutes. Record the PIPA Standby Mode stabilized temperature. The recorded temperature shall be 130.5±1.5 degrees.

6.2.1.5.5 Deleted

6.2.1.5.6 On the Event Recorder, verify that the IMU HEATER Current discrete (CG 2302) is ON and that the IMU BLOWER Current discrete (CG 2303) is OFF over the PIPA Standby Temperature stabilization period (occasionally discretes may cycle.)

6.2.1.5.7 With the eyepiece in the Eyepiece Storage Unit, check the eyepiece surface temperature at the quick disconnect flange using an L&N #8693 Temperature Potentiometer, or a similar type thermocouple probe meter. Record both the ambient and eyepiece surface temperatures and verify that the eyepiece surface temperature is above the ambient temperature by at least 5°F but not more than 30°F.

6.2.3.1.7 Insure that the following alarm lamps are not lighted on G&N LEB Display Panel.

- a. CMC Warning
- b. ISS Warning
- c. PGNS Caution

6.2.3.1.8 Verify that the PROGRAM ALARM lamp on the DSKY's does not light with VERB 05 NOUN 31 and R1 = 00213 displayed.

6.2.3.1.9 Deleted.

6.2.3.1.10 Enter the following into K-148:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.3.1.11 Verify that the following secondary power supply voltages are not flashing on the CRT display.

Table VI. Secondary Power Supply Voltages

Meas. No.	Signal
1 CG 1040	+120 VDC PIPA SUPPLY
2 CG 1051	+20 VDC PIPA SUPPLY
3 CG 1052	-20 VDC PIPA SUPPLY
4 CG 1070	+4 VDC CDU SUPPLY
5 CG 1100	-28 VDC ELECTRONICS
6 CG 1020	+14 VDC CMC SUPPLY
7 CG 1030	+4 VDC CMC SUPPLY
8 CG 1201	IMU 28V 800 CPS 1 pct 0 ph
9 CG 1202	IMU 28V 800 CPS 5 pct ph A
10 CG 1203	IMU 28V 800 CPS 5 pct ph B
11 CG 1331	3.2KC 28V SUPPLY
12 CG 1110	2.5 VDC TM BIAS

6.2.3.1.12 Monitor the PIPA temperature during the first 15 minutes after switching from Standby Mode to the Operate Mode. The PIPA temperature shall be 130.5 ± 2.0 deg. F. during this period. 15 minutes after switching from Standby Mode to the Operate Mode, record the PIPA temperature. The recorded PIPA temperature shall be within 0.5 deg. F. of the Operate stabilized PIPA temperature determined below.

6.2.3.1.13 Deleted

6.2.3.1.14 30 minutes after entering the IMU Operate Mode, start recording PIPA TEMP every 5 minutes until the PIPA temperature is stabilized. The PIPA temperature shall be considered stabilized when the temperature change is not more than 0.1 deg for 30 minutes. Record the PIPA Operate Mode stabilized temperature. The PIPA Operate Mode stabilized temperature shall be 130.5 ± 1.5 deg. F. and within 1.0 deg. F. of stabilized PIPA temperature.

6.2.3.1.15 Deleted

6.2.5 General Turn Off and Turn On Procedure

NOTE: This procedure shall be utilized any time after performing 6.1.3 Prepower Application Requirements 6.2.1, Standby Power On Test, and 6.2.3. Operate Power on Test, to turn on or turn off the G&N System. Appropriate portions of this procedure will be referenced in other tests.

6.2.5.1 Turn Off Procedure

CAUTION: This procedure must be performed in the sequence specified. Failure to adhere to this sequence may require calibration of the inertial components.

6.2.5.1.1 Enter the following sequence into the K-148.

- a. VERB 41 NOUN 20, ENTER
- b. +00000 ENTR
- c. +00000 ENTR
- d. +09000 ENTR

On the G&N Indicator Control Panel verify PGNS light is ON. On the DSKY verify NO ATT light is ON. Verify that the GIMBAL LOCK indicator on the DSKY's illuminated.

6.2.5.1.2 Set the following switches on the G&N Indicator Control Panel to the positions designated.

- a. OPTICS ZERO to ZERO
- b. OPTICS MODE to MAN
- c. OPTICS COUPLING to DIRECT
- d. OPTICS SPEED to MED
- e. OPTICS TEL TRUN to SLAVE to SXT
- f. RETICLE BRIGHTNESS to minimum brightness position

6.2.5.1.3 Set the G/N Power - IMU switch on the LEB Lighting Control Panel to OFF and G&N IMU MN A and MN B circuit breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).

6.2.5.1.4 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF and G&N OPTICS MN A and MN B breakers on the right hand circuit breaker panel to OFF.

6.2.5.1.5 On K-148 enter the following:

VERB 21 NOUN 01 ENTR
00034 ENTR
00000 ENTR
The GIMBAL LOCK and PGNS lamps shall extinguish
VERB 36 ENTR
The NO ATT lamp shall extinguish.

- 6.2.5.1.6 Decrease the LIGHTS-NUMERICS controls on both the left hand circuit breaker panel and the LEB Lighting Control Panel to the minimum brightness - OFF position.
- 6.2.5.1.7 Set the PSAAM power switch on the PSAAM to OFF.
- 6.2.5.1.8 Set the IMU HTR MNA and MN B circuit breakers on the right hand circuit breaker panel to OFF (breakers pulled out).
- 6.2.5.1.9 Set the COMPUTER MN A and MN B circuit breakers on the right hand circuit breaker panel to OFF (breakers pulled out).
- 6.2.5.1.10 Set the G&N Power AC1-OFF-AC2 switch on the right hand circuit breaker panel to OFF and the G&N Power AC1 and AC2 circuit breakers to OFF (breakers pulled out).
- 6.2.5.1.11 Set the LTGNUMERIC/INTGL LEB and LTGNUMERIC/INTGL LMDC circuit breakers to OFF. Verify that the ICTC is supplying inertial components heater power to the G&N System. This will be indicated by the following on the PTC.
- a. G&N ON (PTC inhibit) light not illuminated.
 - b. IMU Temp/heater current meter indicates IMU temperature of 130° ±5°F.
- 6.2.5.2 Turn ON Procedure
- 6.2.5.2.1 Set or verify the following G&N Indicator Control Panel switches to the position indicated.
- a. CONDITION LAMPS to ON
 - b. OPTICS ZERO to ZERO
 - c. OPTICS MODE to MAN
 - d. OPTICS COUPLING to DIRECT
 - e. OPTICS SPEED to LO
 - f. OPTICS TEL TRUN to SLAVE to SXT
 - g. RETICLE BRIGHTNESS to minimum brightness setting.
- Insure that interfacing system EPS and ECS are turned on and operating properly.
- CAUTION: The remaining procedure must be followed in sequence specified. Failure to adhere to this sequence may require recalibration of the inertial components.
- 6.2.5.2.2 Set the G&N Power AC1 and AC2 breakers on the right hand circuit breaker panel to ON (breakers pushed in). Set the G&N Power AC1-OFF-AC2 switch to AC1.

- 6.2.5.2.3 Energize the G&N COMPUTER MN A and MN B breakers on the right hand circuit breaker panel (breakers pushed in). Enter VERB 61 into K-148 and press the ENTER pushbutton. Verify +14 and +4 VDC CMC power supply outputs on CRT display. Voltages shall be +14.0±0.4 VDC (CG1020) and +4.0±0.2 VDC (CG1030).

NOTE: RESTART lamp may illuminate; if it does, disregard and press RSET on the DSKY.

On DSKY verify TEMP light is ON. On the G&N Indicator Control Panel verify PGNS light is ON.

- 6.2.5.2.4 Energize the G&N IMU HTR MN A and MN B breakers on the right hand circuit breaker panel (breakers pushed in). Insure that the CMC +28 VDC discrete lamp on the Event Module is illuminated (CG 1523). Verify TEMP light on DSKY is extinguished. Verify PGNS light on the G&N Indicator Control Panel is extinguished.

- 6.2.5.2.4.1 Set/verify the following switches on the PSAAM:

- a. PSAAM POWER to ON.
- b. INHIBIT VOLTAGE FAIL to OFF.

- 6.2.5.2.5 Set the G&N DSKY and Display Panel brightness to the minimum acceptable level by manipulation of LIGHTS-NUMERICS control on both left hand circuit breaker panel and LEB Light Control Panel.

- 6.2.5.2.6 Enter VERB 36 into K148. Press ENTER pushbutton. Press ERROR RESET pushbutton on K148. All computer alarms except the Gimbal Lock Indicator on the Main Display Console (MDC) and LEB AGC DSKY shall clear. Verify registers R1, R2, and R3 on the DSKY's are cleared. Verify PROG = 00.

- 6.2.5.2.7 Deleted.

- 6.2.5.2.8 Initiate CMC Self-Test by entering the following into the K148:

- a. VERB 21, NOUN 27, ENTER
- b. 77777, ENTER
- c. VERB 15, NOUN 01, ENTER
- d. 01366, ENTER

- 6.2.5.2.8.1 Monitor DSKY until R3 (SCOUNT +2) increments twice. If an error is detected, the following will be displayed.

- a. VERB 05, NOUN 31
- b. R1 = 01102
- c. R2 = XXXXXX c (SFAIL)
- d. R3 = XXXXXX c (ERCOUNT)

- 6.2.5.2.8.2 Terminate the monitor routine by entering the following into the DSKY
VERB 34, ENTER

- 6.2.5.2.8.3 Terminate Self-Test by entering the following into the K-Start:

- a. VERB 21, NOUN 27, ENTER
- b. 00000, ENTER

- b. 23.3 - CC.C = DD.D hours
- c. Add DD.D to the time of day recorded in 6.2.6.1.1. This is the time of day at which the high order scalar, channel 03, will overflow.

Do not enter the G&N Operational test within -0.2 hours of the time of day calculated in step 6.2.6.1.3.c. If the test is in process at this time, unacceptable test results will occur.

6.2.6.2 Initiation

6.2.6.2.1 On K-148, enter the following sequence:

VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR

Wait 15 seconds

VERB 41 NOUN 20 ENTR
+17000 ENTR
+17000 ENTR
+17000 ENTR

Wait 15 seconds

VERB 41 NOUN 20 ENTR
+27000 ENTR
+27000 ENTR
+27000 ENTR

Wait 15 seconds

VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR

Wait 15 seconds

6.2.6.2.2 On K-148 enter the following sequence:

VERB 57 ENTR
00004 ENTR

6.2.6.2.3 Observe VERB 16 NOUN 20 displayed on CRT. The NO ATT discrete shall appear momentarily then go OFF. Verify that the PROGRAM displayed on the CRT indicates 07.

Enter VERB 34 into K148 and press the ENTER pushbutton.

NOTE: During this portion of the test the G&N System is exercised through its modes. Any failures will be indicated by the PROGRAM ALARM lamp on the DSKY's lighting with VERB 05 NOUN 31 and R1 = 01411 displayed.

6.2.6.2.4 After approximately 12 minutes, VERB 06, NOUN 66 will flash and the value of the gravity vector in cm/sec² shall be displayed in R1 and R2 on the CRT. Record these values.

- 6.2.6.2.5 R1 contains the first five digits of the gravity vector and R2 contains the last five digits. A decimal point shall be between them. The value for the gravity vector shall be 980.00000 ± 05.00000 cm/sec².
- 6.2.6.2.6 Enter VERB 33 into K148. Press the ENTER pushbutton.
- 6.2.6.2.7 When VERB 06 NOUN 66 flashes the value of the horizontal earth rate shall be displayed on R1 and R2 on the CRT. Record these values.
- 6.2.6.2.8 R1 contains the first five digits of earth rate and R2 contains the last five digits. A decimal point shall be placed between them. R1 shall always be 00000. The horizontal earth rate shall be 00000.83000 ± 0.1000 earth rate units.
- 6.2.6.3 Test Termination
- 6.2.6.3.1 Enter VERB 36 into K148. Press the ENTER pushbutton.
- 6.2.6.3.2 Enter VERB 41, NOUN 20 into K148. Press the ENTER pushbutton.
- 6.2.6.3.3 Enter +00000 into K148 three times. Press the ENTER pushbutton after each entry.

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6.2.7.2.3 Enter the following into K148.

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table 1 and XXXX is that recorded in 6.2.7.2.2.

TABLE 1

Y (From 6.2.7.2.2)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.7.2.4 Enter the following sequence into the K-Start, pushing the ENTER pushbutton after each entry (+360 IG torquing).

- a. VERB 24 NOUN 01, ENTER
- b. 00407, ENTER
- c. 40000, ENTER
- d. 40034, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

- 6.2.7.2.5 Enter the following sequence into K148:
- VERB 42, press ENTER
 - VERB 33, press ENTER
- 6.2.7.2.6 Start analog recorders.
- 6.2.7.2.7 Verify that IG Servo Error Quadrature (CG 2108) is 0.0 ± 1.2 VRMS. Observe measurement CG 2112, IG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.
- 6.2.7.2.8 Return the G&N System to the coarse align mode by entering the following sequence in the K148.
- VERB 40 NOUN 20 ENTR
Wait 3 seconds
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+17000 ENTR
+17000 ENTR
+17000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+27000 ENTR
+27000 ENTR
+27000 ENTR
Wait 15 seconds
+00000 ENTR
+00000 ENTR
+00000 ENTR
- 6.2.7.2.9 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 30 seconds before proceeding.
- 6.2.7.2.10 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (-360° IG torquing):
- VERB 24 NOUN 01 ENTER
 - 00407, ENTER
 - 37777, ENTER
 - 37743, ENTER
- Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.
- 6.2.7.2.11 Enter the following sequence into K148:
- VERB 42, press ENTER
 - VERB 33, press ENTER

6.2.7.2.12 Start analog recorders.

6.2.7.2.13 Observe measurement CG 2112, IG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.

6.2.7.2.14 Return the G&N System to the coarse align mode by entering the following sequence in the K148:

VERB 40 NOUN 20 ENTR

Wait 3 seconds

VERB 41 NOUN 20 ENTR

+00000 ENTR

+00000 ENTR

+00000 ENTR

Wait 15 seconds

VERB 41 NOUN 20 ENTR

+17000 ENTR

+17000 ENTR

+17000 ENTR

Wait 15 seconds

VERB 41 NOUN 20 ENTR

+27000 ENTR

+27000 ENTR

+27000 ENTR

Wait 15 seconds

+00000 ENTR

+00000 ENTR

+00000 ENTR

6.2.7.2.15 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 30 seconds before proceeding.

6.2.7.3 Outer Gimbal Friction Test

6.2.7.3.1 Set up the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

- a. CG 2180 OG TORQUE MOTOR CURRENT
- b. CG 2177 OGA SERVO ERROR IN PHASE
- c. CG 2172 OG 1X RESOLVER OUTPUT SIN
- d. CG 2173 OG 1X RESOLVER OUTPUT COS
- e. CG 2280 OGA CDU FINE ERROR
- f. CG 2281 OGA CDU COARSE ERROR

6.2.7.3.2 Enter the following sequence into the K148. Pushing the ENTER pushbutton after each entry (+360° OG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00405, ENTER
- c. 40000, ENTER
- d. 40034, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

- 6.2.7.3.3 Enter the following sequence into K148:
- VERB 42, press ENTER
 - VERB 33, press ENTER
- 6.2.7.3.4 Start analog recorders
- 6.2.7.3.5 Observe measurement CG 2172, OG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.
- 6.2.7.3.6 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.
- VERB 40 NOUN 20 ENTR
Wait 3 seconds
VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+17000 ENTR
+17000 ENTR
+17000 ENTR
Wait 15 seconds
VERB 41 NOUN 20 ENTR
+27000 ENTR
+27000 ENTR
+27000 ENTR
Wait 15 seconds
+00000 ENTR
+00000 ENTR
+00000 ENTR
- 6.2.7.3.7 Verify that OG Servo Error Quadrature (CG 2168) is $0.0 \pm 1.2V$ RMS. Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 30 seconds before proceeding.
- 6.2.7.3.8 Enter the following sequence into the K148. Push the ENTER pushbutton after each entry (-360° OG torquing):
- VERB 24 NOUN 01, ENTER
 - 00405, ENTER
 - 37777, ENTER
 - 37743, ENTER
- Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.
- 6.2.7.3.9 Enter the following sequence into K148:
- VERB 42, press ENTER
 - VERB 33, press ENTER

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6.2.7.4.8 Enter the following sequence in the K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER

6.2.7.4.9 Start analog recorders.

6.2.7.4.10 Observe measurement CG 2142, MG 1X Resolver output SIN, on the analog recorder. When the steady-state condition occurs (approximately 5 minutes), stop the recorders.

6.2.7.4.11 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 36, ENTER
- b. VERB 40 NOUN 20, press ENTER
- c. VERB 41, NOUN 20, press ENTER
- d. +00000, press ENTER
- e. +00000, press ENTER
- f. +00000, press ENTER

6.2.7.5 Examine the traces of the recorded measurements for all six phases of this test to detect any sharp discontinuities. Disregard transients of 0.5 second duration or less on the Gimbal Torque Motor current traces and disregard all transients on the CDU Fine Error and CDU Coarse Error traces. The Gimbal Torque motor currents shall not exceed 0.125 ampere. The CDU Fine Error measurements shall not exceed ± 70 mv rms. The CDU Coarse Error measurement shall not exceed ± 80 mv rms.

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6.2.8 G&N Panel Brightness and Lamp Test

6.2.8.1 Proceed with this test if 6.2.5.2 or 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 before proceeding with this test.

6.2.8.2 Rotate the RETICLE BRIGHTNESS thumbwheel on the Control Indicator Panel and verify the capability to control the illumination of the following lamps:

- a. SRT reticles
- b. SRT reticles
- c. Telescope Panel Angle Counters

6.2.8.3 Turn on LIGHTS-INTEGRAL control on Left Hand Circuit Breaker panel and LEB Lighting Control Panel.

6.2.8.4 Adjust the brightness controls on the LEB Lighting Control Panel and Left Hand Circuit Breaker Panel from minimum brightness to maximum brightness. Verify the operation of the G&N Indicator Control Panel lamps.

6.2.8.4.1 Re-adjust brightness controls for minimum acceptable lighting. Turn off LIGHTS-INTEGRAL control on Left Hand Circuit Breaker panel and LEB Lighting Control Panel.

6.2.8.5 Push and hold the CONDITION LAMPS switch on the G&N Indicator Control Panel to TEST. Verify the illumination of the following lamps:

- a. SEAR ACQ
- b. MASTER ALARM lamp

6.2.8.6 Set the CONDITION LAMPS switch to OFF. Lamps a and b in 6.2.8.5... shall extinguish.

6.2.9 Semi-Automatic Moding Check

6.2.9.1 Perform Master Initialization 6.2.5.3 before proceeding.

On K-148, enter the following sequence:

a.	VERB 21 NOUN 01	ENTR
b.	01300	ENTR
c.	40266	ENTR
d.	NOUN 15	ENTR
e.	61304	ENTR ENTR
f.	10000	ENTR ENTR
g.	01325	ENTR ENTR
h.	00023	ENTR ENTR
i.	01325	ENTR ENTR
j.	25546	ENTR ENTR
k.	31344	ENTR ENTR
l.	54324	ENTR ENTR
m.	41345	ENTR ENTR
n.	60150	ENTR ENTR
o.	10000	ENTR ENTR
p.	01332	ENTR ENTR
q.	00050	ENTR ENTR
r.	01332	ENTR ENTR
s.	37640	ENTR ENTR
t.	04451	ENTR ENTR
u.	01337	ENTR ENTR
v.	30005	ENTR ENTR
w.	02324	ENTR ENTR
x.	04505	ENTR ENTR
y.	31315	ENTR ENTR
z.	04451	ENTR ENTR
aa.	01300	ENTR ENTR
ab.	30005	ENTR ENTR
ac.	04505	ENTR ENTR
ad.	31315	ENTR ENTR
ae.	04451	ENTR ENTR
af.	01307	ENTR ENTR
ag.	30005	ENTR ENTR
ah.	04505	ENTR ENTR
ai.	31346	ENTR ENTR
aj.	54150	ENTR ENTR
ak.	54331	ENTR ENTR
al.	05572	ENTR ENTR
am.	04505	ENTR ENTR
an.	00002	ENTR ENTR
ao.	30364	ENTR ENTR
ap.	30376	ENTR

6.2.9.1 aq. VERB 25 NOUN 26 ENTR
(Continued) ar. 00001 ENTR
 as. 01300 ENTR
 at. 30005 ENTR
 su. VERB 31 ENTR

6.2.9.1.1 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Record the indication on the CRT. Verify that OPTX 28V 800 cps 1% Oph (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.

6.2.9.1.2 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.9.1.3 Enter 00010 into K148. Press the ENTER pushbutton.

6.2.9.1.4 Observe VERB 06 NOUN 01 flashes on the CRT and the PROGRAM display indicates 07.

6.2.9.2 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 30 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 02 flashing
- b. R1 = +00000±00007
- c. R2 = +00000±00007
- d. R3 = +00000±00007
- e. IG angle = 000±1 deg.
- f. MG angle = 000±1 deg.
- g. OG angle = 000±1 deg.

6.2.9.3 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 03 flashing
- b. R1 = +04500±00007
- c. R2 = +04500±00007
- d. R3 = +04500±00007
- e. IG angle = 045±1 deg.
- f. MG angle = 045±1 deg.
- g. OG angle = 045±1 deg.

6.2.9.4 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall extinguish. After approximately 100 seconds the following data shall be displayed on the CRT.

- a. VERB 05 NOUN 30 flashing
- b. R1 = 00000±00003
- c. R2 = 00000±00003
- d. R3 = 00000±00003

NOTE: Negative numbers will be displayed in octal complement form, i.e.,
00001 = 77776.

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- 6.2.9.14 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY shall extinguish. After approximately 100 seconds the following data shall be displayed on the CRT.
- VERB 06 NOUN 30 flashing
 - R1 = 00000 ± 00003
 - R2 = 00000 ± 00003
 - R3 = 00000 ± 00003
- 6.2.9.15 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 20 seconds the following data shall be displayed on the CRT.
- VERB 06 NOUN 17 flashing
 - R1 = +28900 ± 00007
 - R2 = +28900 ± 00007
 - R3 = +28900 ± 00007
 - IG angle = 315 ± 1 deg.
 - OG angle = 315 ± 1 deg.
 - MG angle = 289 ± 1 deg.
- The GIMBAL LOCK lamp on the DSKY's shall light. The PGNS caution lamp on the Indicator Control Panel shall light.
- 6.2.9.16 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data will be displayed on the CRT.
- VERB 06 NOUN 20 flashing
 - R1 = +00000 ± 00007
 - R2 = +00000 ± 00007
 - R3 = +00000 ± 00007
 - IG angle = 000 ± 1 deg.
 - MG angle = 000 ± 1 deg.
 - OG angle = 000 ± 1 deg.
- The GIMBAL LOCK lamp on the DSKY's shall extinguish. The PGNS caution lamp on the Indicator Control Panel shall extinguish.
- 6.2.9.17 Enter VERB 33 and press the ENTER pushbutton. The COMP ACTY lamp on the DSKY's shall flash for a few seconds. After approximately 15 seconds the following data shall be displayed on the CRT.
- VERB 06 NOUN 66 flashing
 - R1 = 000xx
 - R2 = xxxxx
- The GIMBAL LOCK lamp on the DSKY's shall light. The PGNS caution lamp on the Indicator Control Panel shall light.
- Record R1 and R2 as the Middle Gimbal CDU drive rate.
MG rate = R1 R2 /sec. The Middle Gimbal CDU drive rate shall be 14 ± 2/sec.

6.2.9.18 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 66 flashing
- b. R1 = 000xx
- c. R2 = xxxxx

The GIMBAL LOCK lamp on the DSKY's shall extinguish. The PGNS caution lamp on the Indicator Control Panel shall extinguish.

Record R1 and R2 as the Inner Gimbal CDU drive rate.
IG rate = $\frac{R1}{R2}$ * /sec. The Inner Gimbal CDU drive rate shall be 14±2"/sec.

6.2.9.19 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 66 flashing
- b. R1 = 000.xx
- c. R2 = xxxxx

Record R1 and R2 as the Outer Gimbal CDU drive rate. OG rate = $\frac{R1}{R2}$.
The Outer Gimbal CDU drive rate shall be 14±2"/sec.

6.2.9.20 Enter VERB 33 into K148. The NO ATT lamp on the DSKY's shall extinguish. Press the ENTER pushbutton. After approximately 20 seconds VERB 21 NOUN 22 shall flash on the CRT. Enter +00100 into K148 three times. Press the ENTER pushbutton after each entry. The NO ATT lamp on the DSKY's shall momentarily light, then extinguish. After approximately 100 seconds VERB 01 NOUN 10 flashing shall be displayed on the CRT. Press the ENTER pushbutton.

Enter 00030 into K148. Press the ENTER pushbutton. Verify R1 = 33xxxx.

The ISS WARNING Lamp on the Indicator Control Panel shall light.
The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be ON.

6.2.9.21 On K-148, insert the following sequence:

VERB 25 NOUN 26 ENTR
00001 ENTR
01300 ENTR
30005 ENTR
VERB 31 ENTR
VERB 33 ENTR

ISS WARNING and ISS CDU FAIL shall be OFF. After approximately 20 seconds, VERB 21 NOUN 22 shall flash on the CRT. Enter +03375 into K-148 three times. Press the ENTER pushbutton after each entry. The NO ATT lamp on the DSKY's shall momentarily light, then extinguish. After approximately 100 seconds, VERB 01 NOUN 10 flashing shall be displayed on the CRT. Press the ENTER pushbutton.

6.2.9.21
(Continued)

Enter 00000 into K-148. Press the ENTER pushbutton. Verify R1 = 33XXX.

The ISS WARNING lamp on the Indicator Control Panel shall light. The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be ON.

6.2.9.22 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 20 seconds VERB 06 NOUN 55 shall flash on the CRT. The ISS WARNING lamp on the Control Indicator Panel shall extinguish. The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be OFF.

6.2.9.23 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Set the OPTICS MODE switch to CMC.

6.2.9.24 Enter VERB 33 into K-148 and press the ENTER pushbutton. After approximately 25 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 06 flashing
- b. R1 = 000xx
- c. R2 = xxxxx

Record R1 and R2 as the Shaft Optics CDU drive rate.
Shaft rate = $\frac{R1}{R2}$. The Shaft Optics CDU drive rate shall be $7.32 \pm 1.83^\circ / \text{sec}$.

6.2.9.25 Enter VERB 33 into K148. Press the ENTER pushbutton. In about 15 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 06
- b. R1 = 0000x
- c. R2 = xxxxx

Record R1 and R2 as the Trunnion Optics CDU drive rate. Trunnion rate = $\frac{R1}{R2}$. The Trunnion Optics CDU drive rate shall be $1.83 \pm 0.45^\circ / \text{sec}$.

6.2.9.26 Terminate the Semi-Automatic Moding Check by entering VERB 34 into K148. Observe PROG display on DSKY's is 00. Press the ENTER pushbutton. Set the G&N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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6.2.10 Zero Optics Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 Turn On procedure before proceeding.

INITIALIZATION

6.2.10.1 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $\pm 28.0 \pm 3.0$ VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.10.2 Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.

- VERB 41 NOUN 20 ENTER
- +00000, ENTER
- +00000, ENTER
- +00000, ENTER

6.2.10.3 Insure that the following switches on the G&N Indicator Control Panel are set as follows:

- OPTICS TEL TRUNN to SLAVE TO SXT
- OPTICS COUPLING to DIRECT
- OPTICS SPEED to HI
- OPTICS MODE to MAN

OPTICS ZERO MODE TEST

6.2.10.4 Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K-148. Press the ENTER pushbutton.

6.2.10.5 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 6 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following on R1 and R2 of the DSKY.

- R1 = $\pm 0.00^\circ \pm 0.02^\circ$, -0.03° (Shaft Angle)
- R2 = $\pm 0.000^\circ \pm 0.006^\circ$, -0.007° (Trunnion Los Angle)

VERB 16 NOUN 55 ENTER

Record the TPAC indications. The Shaft Angle shall be 0.0 ± 0.11 degrees. The Trunnion Angle shall be 0.0 ± 0.22 degrees.

6.2.10.5.1 Enter the following:

VERB 01 NOUN 10, ENTER
00033, ENTER
Verify R1 = XXX6X

6.2.10.5.2 Return the OPTICS ZERO switch to OFF. Set the OPTICS MODE switch to CMC. Enter the following:

ENTER
00033, ENTER
Verify R1 = XXX6X

6.2.10.5.3 Set the OPTICS MODE switch to MAN. Press the KEY REL pushbutton on the DSKY.

OPTICS TIME TO ZERO TEST

6.2.10.6 Deleted.

6.2.10.7 Deleted.

6.2.10.8 Deleted.

6.2.10.9 Deleted.

6.2.10.10 Deleted.

6.2.10.11 Deleted.

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- 6.2.10.12 Set the OPTICS ZERO switch on the G&N Indicator Control Panel to OFF. Set the G&N Power Optics Switch on the LEB Lighting Control Panel to OFF.

OPTICS BACKUP MODE TEST

- 6.2.10.13 Insert the inflight tool (V36601405) into the Trunnion Tool input and engage drive mechanism (button out). Verify that the trunnion turns by viewing the movement through the SCT eyepiece while turning the tool until the TPAC reads +5 deg. Remove the tool from the trunnion tool input.
- 6.2.10.14 Insert the inflight tool (V36601405) into the Shaft Tool input and engage the drive mechanism (button out). Verify that the Shaft turns by viewing the movement through the SCT eyepiece while turning the tool so that the shaft moves through an angle from 0° to +3° to 0 as indicated on the shaft TPAC. Disengage the shaft drive mechanism (button in) and remove the tool.
- 6.2.10.15 Insert the inflight tool (V36601405) into the Trunnion Tool input. Verify that the Trunnion turns by viewing the movement through the SCT eyepiece while turning the tool so that the trunnion moves from +5° to -5° and back to zero as indicated on the Trunnion TPAC. Disengage the trunnion drive mechanism (button in) and remove the tool.

6.2.11 OPTICS Coordinate Transformation Control Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding.

INITIALIZATION

- 6.2.11.1 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1630) is +28.0±0.3 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.
- 6.2.11.2 Enter the following into the K-Start. Press the ENTER pushbutton after each entry.
- VERB 41 NOUN 20, ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER
- 6.2.11.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the position indicated.
- OPTICS TEL TRUN to SLAVE to SXT
 - OPTICS COUPLING to DIRECT

- c. OPTICS SPEED to HI
- d. OPTICS MODE to MAN

6.2.11.4 Set up the analog recorders to monitor the following measurements:

- a. CG 3170 SCT Trunnion Tachometer Output

6.2.11.5 Enter the following into the K-Start to monitor the OPTICS CDU's.

VERB 16 NOUN 55, press ENTER

6.2.11.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the G&N Panel to ZERO. Wait 15 seconds. Return the OPTICS ZERO switch to OFF.

RESOLVED MODE PHASING AND IMAGE RATE TEST

6.2.11.7 Using the OPTICS CONTROL STICK, drive the Optics until R1 = +225.00 and R2 = +10.000 on the CRT and the DSKY's.

6.2.11.8 Set the OPTICS COUPLING switch on the G&N Panel to RSLV and controller speed switch to MED.

6.2.11.9 Position the movable optics target such that it is centered on the SCT retical pattern, then start the analog recorders.

6.2.11.10 Quickly displace the OPTICS CONTROL STICK 45 ± 10 degrees in the upper right hand quadrant while sighting on the optics target through the SCT eyepiece. The target shall appear to move in the upper right field of view of the SCT at 45 ± 10 deg. When target leaves the SCT upper right field of view press MARK pushbutton and immediately record the shaft angle as displayed on R1 of the DSKY. The recorded shaft angle shall be $+225 \pm 10.00$ degrees.

6.2.11.11 Stop the analog recorder and measure the elapsed time between the initial and the final signal null conditions for the trunnion measurement. The elapsed time shall be +19 to +32 seconds.

CSC AMPLIFIER SHAFT AND TRUNNION DRIVE TEST

6.2.11.12 Set the OPTICS COUPLING switch to DIRECT. Again using the OPTICS CONTROL STICK, drive the optics until R1 = +225.00 and R2 = +10.000. Set the OPTICS COUPLING switch to RSLV.

6.2.11.13 While sighting on the optical target through the SCT eyepiece displace the OPTICS CONTROL STICK fully to the right. Verify that the target image appears to move in a straight line horizontally to the right and release the OPTICS CONTROL STICK when the target image reaches the edge of the SCT field of view.

6.2.11.14 Enter VERB 34 in the DSKY.
Press the ENTER pushbutton.

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- 6.2.11.15 Set the OPTICS COUPLING switch on the G&N Panel to DIRECT. Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion Slaved to SXT). Set the OPTICS ZERO switch to ZERO.

NOTE: If Optics testing will continue, set the G/N POWER OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.12 Optics Functional Test

Proceed with this test if 6.2.3 Operate Power On Test, or 6.2.5.2, Turn-On Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2, Turn On Procedure, before proceeding.

NOTE: This test requires the use of the G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT SLOS before proceeding. Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.

6.2.12.1 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Set Tracker switch to OFF. Verify the following:

- +28 VDC OPTX OPERATE BUS (CG 1530) is 28.8±3 VDC. Record the indication on the CRT.
- CG 1211 OPTX 28V 800 cps 1% 0 ph not flashing on CRT.
- CG 1212 OPTX 800 cps 5% - 90 ph not flashing on CRT.

6.2.12.2 Enter the following sequence into the K-Start.

- VERB 41, NOUN 20, ENTER
- +00000, ENTER
- +00000, ENTER
- +00000, ENTER

6.2.12.3 Insure that Optics Control switches on the G&N Indicator Control Panel are set as follows:

- OPTICS ZERO to OFF
- OPTICS MODE to MAN
- OPTICS SPEED to LO
- OPTICS COUPLING to DIRECT
- OPTICS TEL TRUN to SLAVE to SXT

- 6.2.12.4 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. After 15 seconds return the switch to OFF.
- 6.2.12.5 Resolution Checks
- 6.2.12.5.1 Sight through the SXT eyepiece. Using the OPTICS CONTROL STICK, adjust the SXT to obtain the best reflected field of view of the 5-inch autocollimator reticle engravings at the center of the field of view.
- 6.2.12.5.2 Note that the autocollimator reticle contains a series of lines of different thickness and width. Each set of lines is marked with a number (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines. The SXT resolution shall be at least 10 arc-seconds at the center of the field of view.
- 6.2.12.5.3 Repeat 6.2.12.5.1 and 6.2.12.5.2 using the SCT and the SCT resolution chart. The SCT shall have a resolution of at least 3 arc-minutes at the center of the field of view.
- 6.2.12.6 Slave Telescope Mode Checks
- 6.2.12.6.1 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.6.2 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the Control Indicator Panel to ZERO. Wait 15 seconds
- 6.2.12.6.3 Record the SCT Shaft and Trunnion angles as indicated by the TPAC and the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between the TPAC Shaft angle and the Shaft CDU angle shall be ± 0.11 degree or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be ± 0.22 degree or less.
- 6.2.12.6.4 Place the OPTICS ZERO switch to OFF. Using the OPTICS CONTROL STICK drive the SXT Shaft and Trunnion CDU's until $R1 = +035.00 \pm 0.10$ degree and $R2 = 35.000 \pm 0.100$ degree, setting the CONTROLLER SPEED switch to LO as the angles are approached. Press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles as indicated by the TPAC. Record R1 and R2. The difference between the TPAC Shaft angle and the Shaft CDU angle shall be ± 0.11 deg or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be ± 0.22 deg or less.

- 6.2.12.6.5 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO.
- 6.2.12.6.6 Set the OPTICS TEL TRUN switch to SLAVE to SXT position.
- 6.2.12.6.7 Remove the plug from the base of the SXT eyepiece and install the Adapter Assembly and Portable Light Assembly. Turn on the light.
- NOTE: If needed to reduce external light, place a photographer's hood over the optics head and retroreflecting prism.
- 6.2.12.6.8 Sight through the SCT eyepiece and provide direction to personnel outside spacecraft for positioning the Retroreflecting Prism, Model No. A23-200, to span between the SXT LLOS and SCT LOS such that the illumination from the back-light filament is clearly visible at the center of the field of view. Prism must be held in this alignment position until completion of Step 6.2.12.6.11.
- 6.2.12.6.9 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Note the verticle displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement, expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. For instance, the outer ends of the SXT reticle lines are 6% from center. Displacement shall be less than 50% (bar must be closer to center than to edge of field of view).
- 6.2.12.6.10 Set the OPTICS TEL TRUN switch to 0° position.
- 6.2.12.6.11 Again direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in Step 6.2.12.6.9. Place the OPTICS MODE switch to MAN and observe the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. Displacement shall be less than 50%.
- 6.2.12.6.12 Remove the Retroreflecting Prism.
- 6.2.12.6.13 Replace the Portable Light in the adapter on the SXT eyepiece.
- 6.2.12.6.14 While sighting into the SCT eyepiece, set the OPTICS TEL TRUN switch to 25 deg. and observe that the resolution pattern mounted outside the spacecraft appears to move downward from the center of the field of view to the zero reticle marking that is 25 deg. below the center of the field of view.
- 6.2.12.6.15 Record the TPAC Trunnion Angle. It shall be $25.00^\circ \pm 1.0^\circ$.

- 6.2.12.6.16 Set the OPTICS TEL TRUN switch to SLAVE TO SXT. Set the OPTICS ZERO switch to OFF.
- 6.2.12.7 SXT Parallelism Tests
- 6.2.12.7.1 Using the OPTICS CONTROL STICK drive the SXT StLOS Trunnion to $+15.000 \pm 2$ degree as indicated in R2 of the DSKY. Maintain a Shaft CDU angle of 000.00 ± 0.10 degree as indicated by R1 on the DSKY.
- 6.2.12.7.2 Sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to superimpose the SXT LLOS horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.
- 6.2.12.7.3 Repeat 6.2.12.7.2 twice. Calculate and record the average of the three autocollimator readings.
- 6.2.12.7.4 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO.
- 6.2.12.7.5 Again sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to bring the SXT StLOS horizontal reticle and autocollimator horizontal filar images to coincide. Record the autocollimator reading.
- 6.2.12.7.6 Repeat 6.2.12.7.5 twice. Calculate and record the average of the three autocollimator readings. The average value obtained here shall not differ from that obtained in 6.2.12.7.3 by more than 10 arc-seconds.
- 6.2.12.7.7 Set the OPTICS ZERO switch to OFF. Using the OPTICS CONTROL STICK drive the SXT Trunnion angle to 85.000 ± 5 degrees as indicated on R2 of the DSKY. Set the OPTICS SPEED to LO and drive the SXT Trunnion to $+90.000 \pm 0.100$ degrees as indicated on R2 of the DSKY. Insure that the SXT Shaft angle remains at 000.00 ± 0.10 degrees as indicated by R1 on the DSKY.
- 6.2.12.7.8 Sight through the SXT. Two reticle patterns shall be visible. Use the OPTICS CONTROL STICK to adjust the SXT Trunnion angle until the two horizontal reticle lines are coincident. Record the Trunnion CDU angle displayed in R2. The Trunnion CDU angle shall be 90.000 ± 0.010 degrees.
- 6.2.12.7.9 Remove the Portable Light Assembly and Adapter Assembly from the base of the SXT eyepiece. Replace the SXT eyepiece plug.
- NOTE: If Optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.
- 6.2.12.8 Shaft and Trunnion Positional Accuracy Checks
- 6.2.12.8.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. After 15 seconds, return the selector to OFF.
- 6.2.12.8.2 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton.

- 6.2.12.8.3 Sight through the SXT. Using the control stick align the SXT SLOS with optical target No. 1 on the G&N Installation Fixture Model No. A23-097. Set the OPTICS SPEED switch to LO as the target is approached. When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.
- 6.2.12.8.4 Sight through the SXT. Using the control stick align the SXT SLOS with optical target No. 2 on A23-097. Set the OPTICS SPEED switch to LO as the target is approached.
- 6.2.12.8.5 When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.
- 6.2.12.8.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. After 15 seconds set the switch to OFF. Set the OPTICS MODE switch to CMC.
- 6.2.12.8.7 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.8 Enter the value recorded from R1 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.9 Enter the value recorded from R2 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.10 Sight through the SXT. The SLOS should be centered on Optical Target No. 1 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.3 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.11 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.12 Enter the value recorded from R1 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.13 Enter the value recorded from R2 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.14 Sight through the SXT. The SLOS should be centered on Optical Target No. 2 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.5 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.15 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. After 15 seconds return the switch to OFF.

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- 6.2.12.8.16 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start 3 times. Press the ENTER pushbutton after each entry.
- 6.2.13 Optics Slew Rate Test
- NOTE: Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.13.1 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.
- 6.2.13.2 Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.
- VERB 41 NOUN 20, ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER
- 6.2.13.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the positions indicated.
- TEL TRUN to SLAVE to SXT
 - OPTICS COUPLING to DIRECT
 - OPTICS SPEED to HI
 - OPTICS MODE to MAN
- 6.2.13.4 Monitor MARK COMMAND by entering VERB 06 NOUN 56 into K-148. Press the ENTER pushbutton.
- TRUNNION SLEW RATE - HI SPEED
- 6.2.13.5 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees to zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch on the G&N Indicator Control Panel to OFF.
- NOTE: Read and understand step 6.2.13.6 before proceeding. Do not hold Control Stick at upper limit more than 10 seconds, or exceed a trunnion angle of 85 degrees.
- 6.2.13.6 While slewing the optics, record the following signals: SXT TRUN SERVO error (CG 3118), SXT TRUN TACH (CG 3150), and SXT TRUN TACH (CG 3170). CG 3118 shall be between -0.25 and +2.5 VRMS. ~~CG 3150 shall be between -0.25 and +2.5 VRMS.~~ CG 3150 shall be 3.3±1.3 VRMS. CG 3170 shall be and +0.25±0.25 VRMS. The display in 10 and 15 within 2 seconds.

6.2.13.6
(Continued)

Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds.

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(before display changes). The data displayed is in the following form:

- a. R2 = ±XX.XXX (Trunnion LOS angle in deg)
- b. R3 = +XXX.XX (Time in seconds)

After the display has changed, again record the value of R2 and R3.

6.2.13.7

Perform the following calculations:

NOTE: In performing calculation b. below, and in similar calculations throughout this test procedure, the following shall be noted and taken into account. It is possible that the second R3 reading may be smaller than the first reading. If so, add an overflow time value of 163.84 sec to the second reading and then subtract the first reading, in order to obtain Δ time as the difference of the two R3 readings.

- a. Difference between R2 displays = _____ (Δ trun. angle)
- b. Difference between R3 displays = _____ (Δ time)
- c. $\frac{\Delta \text{trun. angle}}{\Delta \text{time}} = \text{---}^\circ \text{---} \text{deg/sec}$

The trunnion slew rate shall be 10±2 deg/sec.

SHAFT SLEW RATE - HI SPEED

6.2.13.8

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slewed to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand step 6.2.13.9 before proceeding. Do not hold Control Stick at right limit for more than 10 seconds, or exceed a shaft angle of 250 degrees.

6.2.13.9

While slewing the optics, record the following signals: SXT SHAFT SERVO error (CG 8117), SXT SHAFT TACH (CG 8140), and SCT SHAFT-TACH (CG8160). CG 8117 shall be between -0.2 and -2.0 VRMS. CG 8140 shall be 3.3±1.8 VRMS. CG 8160 shall be -3.3±1.8 VRMS. Push and hold the Optics Control stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 sec (before display changes). The data displayed is in the following form: ±XXX.XX (Time in seconds.)

- a. R1 = ±XXX.XX (Shaft angles in deg.)
- b. R3 = +XXX.XX (Time in seconds.)

After the display has changed, again record the values of R1 and R3.

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6.2.13.10

Perform the following calculations:

- a. Difference between R1 displays = ____ (Δ shaft angle)
- b. Difference between R3 displays = ____ (Δ time)
- c. $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{____ deg/sec}$

The Shaft Slew Rate shall be 19.5 ± 3.9 deg/sec
TRUNNION SLEW RATE - MED SPEED

6.2.13.11

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Set the OPTICS SPEED switch to MED. Monitor MARK command by entering VERB 06 NOUN 56 in K148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.12 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

6.2.13.12

Record the SXT TRUN MTR control winding (CG 3155), SXT TRUN SERVO error

6.2.13.12

Record the SXT TRUN MTR control winding (CG 3155) signal on the CRT while slewing the optics. CG 3155 shall be +0.25 to +2.00 VRMS. Push and hold the Optics Control Stick to its upper limit. Release the stick. Approximately 3 seconds later press the MARK pushbutton. Approximately 8 seconds after the first MARK, again press the MARK pushbutton, release the control stick and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 3 seconds (before display changes). The data displayed is in the following form:

- a. R2 = +XX.XXX (Trunnion LOS angle in deg)
- b. R3 = +XXX.XX (Time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.13

Perform the following calculations:

- a. Difference between R2 displays = ____ (Δ trunnion angle)
- b. Difference between R3 displays = ____ (Δ time)
- c. $\frac{\Delta \text{trunnion angle}}{\Delta \text{time}} = \text{____ deg/sec}$

The Trunnion Slew Rate shall be 1.0 ± 0.2 deg/sec.

SHAFT SLEW RATE - MED SPEED

6.2.13.14

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to MAN. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.15 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.15

Record the EXT SHAFT MTR control winding (CG 3145) signal on the CRT while slewing the optics. CG 3145 shall be +0.50 to +4.0 VERMS. Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R1 = +XXX.XX (Shaft angles in deg)
- b. R3 = +XXX.XX (Time in seconds)

After the display has changed, again record the values of R1 and R3.

6.2.13.16

Perform the following calculations:

- a. Difference between R1 displays = ____ (Δ shaft angle)
- b. Difference between R3 displays = ____ (Δ time)
- c. $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{____ deg/sec}$

The Shaft Slew Rate shall be $2.0 \pm 0.4 \text{ deg/sec}$.

TRUNNION SLEW RATE - LO SPEED

6.2.13.17

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Set the OPTICS SPEED switch to LO. Monitor MARK command by entering the VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.18 before proceeding. Do not hold control stick at upper limit for more than 30 seconds.

6.2.13.18

Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 sec (before display changes). The data displayed is in the following form:

- a. $R2 = \pm XX.XXX$ (Trunnion LOS angle in deg)
- b. $R3 = +XXX.XX$ (Time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.19

Perform the following calculations:

- a. Difference between R2 displays = $___\cdot____$ (Δ trunnion angle)
- b. Difference between R3 displays = $___\cdot____$ (Δ time)
- c. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}} = _\cdot____ \text{ deg/sec.}$

The Trunnion Slew Rate shall be $0.10 \pm 0.02 \text{ deg/sec.}$

SHAFT SLEW RATE - LO SPEED

6.2.13.20

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Monitor MARK command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.21 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.21

Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 sec (before display changes). The data displayed is in the following form:

- a. $R1 = \pm XXX.XX$ (Shaft angle in deg)
- b. $R3 = +XXX.XX$ (Time in seconds)

After the display has changed, again record the values of R1 and R3.

6.2.13.22

Perform the following calculations:

- a. Difference between R1 displays = $___\cdot____$ (Δ shaft angle)
- b. Difference between R3 displays = $___\cdot____$ (Δ time)
- c. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = _\cdot____ \text{ deg/sec}$

The Shaft Slew Rate shall be $0.20 \pm 0.04 \text{ deg/sec.}$

OPTICS HAND CONTROLLER DRIFT RATE CHECK - LO SPEED

6.2.13.23

On K-148, enter VERB 06 NOUN 56 ENTER. Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF.

6.2.13.24

Press and release MARK pushbutton. Approximately 60 seconds after the first MARK, again press and release MARK pushbutton. Verify KEY RELEASE is flashing. Press KEY RELEASE pushbutton and record data in R1, R2 and R3 within 2 seconds. When DSKY display changes, again record R1, R2 and R3. The data display is in the following form:

- a. R1 = +XXXX.XX (Shaft Angle in Degrees)
- b. R2 = +XX.XXX (Trunnion Angle in Degrees)
- c. R3 = +XXX.XX (Time in Seconds)

6.2.13.25

Perform the following calculations (first display minus second display):

- a. Difference between R1 displays = _____ (Δ shaft angle)
- b. Difference between R2 displays = _____ (Δ trunnion angles)
- c. Difference between R3 displays = _____ (Δ time)
- d. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \text{_____ deg/sec (shaft drift rate)}$
shall be less than 0.0333 deg/sec.
- e. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}} = \text{_____ deg/sec (trunnion drift rate)}$
shall be less than 0.0167 deg/sec.

6.2.13.26

Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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- 6.2.14 Stabilization Loop Step Response Test
- 6.2.14.1 Proceed with this test if the Operate Power On Test of 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding.
- 6.2.14.2 Insure that the Carry-on Command Stimuli Unit, Model No. C14-200, is installed and connected.
- 6.2.14.3 Enter VERB 36 into K148. Press the ENTER pushbutton, then the ERROR RESET pushbutton.
- 6.2.14.4 Inner Gimbal Response Test
- 6.2.14.4.1 Enter code 2032000000 in C-START Module 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2117 IGA SERVO ERROR on 4A1-A3-CH1.
- 6.2.14.4.2 Enter VERB 41 NOUN 20 into K148. Press ENTER pushbutton.
- 6.2.14.4.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.
- 6.2.14.4.4 Enter VERB 42 into K148. Press ENTER.
- 6.2.14.4.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.
- 6.2.14.4.6 Enter 0001 into R154. Verify and execute to apply +28 VDC ACE ENABLE to the PSAAM.
- 6.2.14.4.7 Enter 1000 into R155. Verify and execute to enter a DC step into the IG stabilization loop.
- CAUTION: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.
- 6.2.14.4.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.
- 6.2.14.4.9 Enter 0000 into 4A2-A6-R155; the top part of switch should be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the IG Stabilization Loop. The bottom part of switch shall be extinguished.
- 6.2.14.4.10 After the transient has died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step input and the settling of the error signal to a value equal to ± 5 percent of the original step amplitude. In addition, record the total number of overshoots.

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- 6.2.14.4.10.1 The inner gimbal stabilization loop response time shall be less than 0.1 second.
- 6.2.14.4.10.2 The maximum number of overshoots on the IGA Servo Error signals shall be three.
- 6.2.14.5 Middle Gimbal Response Test
- 6.2.14.5.1 Enter code 2028000000 into C-START MODULE 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2147 MGA SERVO ERROR on 4A1-A3-CHI.
- 6.2.14.5.2 Enter VERB 41 NOUN 20 into K148. Press ENTER.
- 6.2.14.5.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.
- 6.2.14.5.4 Enter VERB 42 into K148. Press ENTER.
- 6.2.14.5.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.
- 6.2.14.5.6 Enter 0100 into 4A2-A6-R155. The top part of switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.
- 6.2.14.5.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the MG Stabilization Loop.
- CAUTION: If the transient caused by the step input does not die within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.
- 6.2.14.5.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.
- 6.2.14.5.9 Enter 0000 into 4A2-A6-R155. The top part of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press XEQ/SEAL pushbutton to remove the step input to the MG stabilization loop.
- 6.2.14.5.10 After the transients have died out, stop the analog recorder. Record the stab loop response time by measuring the time interval between removing the step input and the settling of the error signals to a value equal to ± 5 percent of the original step amplitude. In addition, record the total number of overshoots.
- 6.2.14.5.10.1 The middle gimbal stabilization loop response time shall be less than 0.1 second.
- 6.2.14.5.10.2 The maximum number of overshoots on the MGA Servo Error signals shall be three.

APOLLO 1002325

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APOLLO G&N Specification
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6.2.14.6 Outer Gimbal Response Test

6.2.14.6.1 Enter code: 2026000000 in C-START Module 4A1-A5-C156. Press XEQ/SEAL Pushbutton to call up OG 2177 OGA SERVO ERROR on 4A1-A3-CH1.

6.2.14.6.2 Enter VERB 41 NOUN 20 into K148. Press ENTER.

6.2.14.6.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.

6.2.14.6.4 Enter VERB 42 into K148. Press ENTER pushbutton.

6.2.14.6.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.

6.2.14.6.6 Enter 0010 into 4A2-A6-R155. The top half of the switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.

6.2.14.6.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the OG Stabilization Loops.

NOTE: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.

6.2.14.6.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.

6.2.14.6.9 Enter 0000 into 4A2-A6-R155. The top half of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the OG Stabilization Loop.

6.2.14.6.10 After the transients have died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step input and the settling of the error signal to a value equal to 25 percent of the original step amplitude. In addition, record the total number of overshoots.

6.2.14.6.10.1 The outer gimbal stabilization loop response time shall be less than 0.1 second.

6.2.14.6.10.2 The maximum number of overshoots on the OGA Servo Error Signals shall be five.

6.2.14.7 Enter VERB 40 NOUN 20 into K148. Press the ENTER pushbutton.

6.2.14.7.1 Enter VERB 41 NOUN 20 into K148. Press the ENTER pushbutton.

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- 6.2.14.7.2 Enter +00000 into K148. Press the ENTER pushbutton.
- 6.2.14.7.3 Enter +00000 into K148. Press the ENTER pushbutton.
- 6.2.14.7.4 Enter +00000 into K148. Press the ENTER pushbutton.

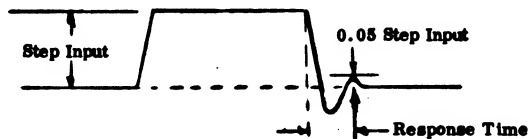


Figure 1. Typical Step Input Response

- 6.2.14.7.5 Enter 0000 into R154. Verify and execute to remove +28 VDC ACE ENABLE.
- 6.2.15 IRIG Scale Factor Test
- 6.2.15.1 Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.15.2 Verify that the IMU OPERATE power has been applied for a minimum of 1 hour, and that at least 1 hour has elapsed since running of the Gimbal Friction Test, 6.2.7.
- 6.2.15.3 Set up the Analog Recorders to monitor the following signals:
- a. CG 2117 IG SERVO ERROR
 - b. CG 2147 MG SERVO ERROR
 - c. CG 2177 OG SERVO ERROR
 - d. CG 2120 IG TM CURRENT
 - e. CG 2150 MG TM CURRENT
 - f. CG 2180 OG TM CURRENT
- 6.2.15.3.1 Start the analog recorder chart drive using a chart speed of 1 mm/sec. The recorder shall run for the duration of 6.2.15.
- 6.2.15.4 Enter VERB 57 into K148. Press the ENTER pushbutton.
- 6.2.15.5 Enter 00005 into K148. Press the ENTER pushbutton. Program 07 shall be displayed.
- 6.2.15.6 VERB 06 NOUN 61 shall flash on CRT and the following displayed in R1 and R2:
- R1 = +xxxxx (some Nav. Base azimuth)
- R2 = +xxxxx (some test site latitude; see Table I)

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6.2.15.7 If the values displayed in R1 and R2 are correct, proceed with test, if not perform the following sequence:

- a. To correct R1, on the K-start enter VERB 21, press ENTER pushbutton, ~~XXXX.XX~~, press ENTER (~~XXXX.XX~~ is correct nav. base azimuth).
- b. To correct R2, on the K-start enter VERB 22, press ENTER pushbutton, ~~XXX.XXX~~, press ENTER (obtain correct site latitude from Table I).

Verify values in R1 and R2 are correct.

Table I

<u>Site</u>	<u>Latitude</u>
NAA	+33.921
MSC	+29.556
MILA	+28.516

6.2.15.8 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)

+00001 ENTR

NOTE: If PROG lamp changes from 07 to 00 during next step or PROG ALARM is on, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.8.

6.2.15.9 In approximately 160 seconds VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (+X IRIG Scale Factor error in part per million, Position +00001).

6.2.15.10 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)

+00002 ENTR

NOTE: If PROG lamp changes from 07 to 00 during next step or PROG ALARM lamp is on, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.7 and 6.2.15.10.

6.2.15.11 In approximately 160 seconds VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (+Y IRIG Scale Factor error in parts per million Position +00002).

6.2.15.12 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)

+00003 ENTR

NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM lamp is ON, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.7 and 6.2.15.12.

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6.2.15.13 In approximately 160 seconds VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (-Z IRIG Scale Factor error in parts per million, position +00003).

6.2.15.14 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
-00001 ENTR

NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM lamp is on, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.7 and 6.2.15.14.

6.2.15.15 In approximately 160 seconds, VERB 05 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (-X IRIG Scale Factor error in parts per million, Position -00001).

6.2.15.16 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
-00002 ENTR

NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM lamp is ON, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.7 and 6.2.15.16.

6.2.15.17 In approximately 160 seconds, VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (-Y IRIG Scale Factor error in parts per million, Position -00002).

6.2.15.18 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
-00003 ENTR

NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM is ON, enter VERB 36 ENTR and repeat steps, 6.2.15.4 through 6.2.15.7 and 6.2.15.18.

6.2.15.19 In approximately 160 seconds, VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (+Z IRIG Scale Factor error in parts per million, Position -00003).

6.2.15.20 Repeat steps 6.2.15.8 through 6.2.15.19 twice to obtain second and third set of data.

6.2.15.21 Terminate this test by entering in K-148: VERB 34 ENTR

6.2.15.22 The average of the three readings of Scale Factor Error for each of the 6 positions shall be 0±1750 PPM.

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- 6.2.16 IMU Performance Test
- 6.2.16.1 Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.16.2 Enter VERB 01 NOUN 10 into K148. Press the ENTER pushbutton. Enter 00003 into K148. Press the ENTER pushbutton. Record R1 = AAAAA and the time of day.
- 6.2.16.3 Enter VERB 21 NOUN 02 into K148. Press the ENTER pushbutton. Enter 01300 into K148. Press ENTER. Enter AAAAA into K148. Press ENTER.
- 6.2.16.4 Enter VERB 06 NOUN 02 into K148. Press ENTER. Enter 01300 into K148. Press ENTER. Record R1 = BBBB.
- 6.2.16.5 Perform the following calculations:
- $$\frac{R1 (BBBB) \times 5.12}{3600} = CCCC.C \text{ (hrs. in high order scaler channel 3)}$$
 - $23.3 - CCCC.C = DDDDD \text{ Hrs.}$
 - Add DDDDD to time of day recorded in step 1.
- Do Not enter any of the PIPA scale factor tests within -0.2 hours of the time of day calculated in step 6.2.16.5c. This is the time at which the high order scaler channel 3, will overflow. If a PIPA scale factor test is being performed at this time, unacceptable test results will occur.
- 6.2.16.6 Verify that the IMU Operate Power has been applied for at least one hour.
- 6.2.16.7 Test Initiation.
- 6.2.16.7.1 Enter the following into K148.
- VERB 01 NOUN 01, ENTER
 - 00362, ENTER
Record R1 = XXXXY
- 6.2.16.7.2 Enter the following into K148
- VERB 21 NOUN 01, ENTER
 - 00362, ENTER
 - XXXXY', ENTER where Y' is determined by Table XV and XXXX is that recorded in 6.2.16.7.1.
- TABLE XV
- | Y (from 6.2.16.7.1) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---------------------|---|---|---|---|---|---|---|---|
| Y' | 2 | 3 | 2 | 3 | 6 | 7 | 6 | 7 |
- 6.2.16.7.3 Enter VERB 57 into K148. Press the ENTER pushbutton.
- 6.2.16.7.4 Enter 00001 into K148. Press the ENTER pushbutton.
- 6.2.16.7.5 On the CRT, DSKY display verify R1 (Navigation Base Azimuth) and R2 (Site Latitude) are correct.

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6.2.16.7.6 If values for R1 and R2 are correct, proceed to next step. If values for R1 and R2 are incorrect, enter the following sequence into K-148.

VERB 24 ENTR

+XXX.XX ENTR (Correct navigation base azimuth ± 0.50 deg)

+XX.XXX ENTR (Correct site latitude from Table XX)

Verify values in R1 and R2 are correct

TABLE XX

<u>LOCATION</u>	<u>LATITUDE</u>
NAA	+33.921
MSC	+29.556
MILA	+28.516

6.2.16.7.7 On K-148 enter the following sequence:

VERB 33 ENTR

VERB 06 NOUN 66 shall flash

6.2.16.7.8 On CRT, DSKY display, verify R1 = +00900 (Time), R2 = +00000 (Test Index No.), and R3 = +00001 (Test Position). If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR

+00900 ENTR (Test Time in Seconds)

+00000 ENTR (Test Index Number)

+00001 ENTR (Test Position Entry)

6.2.16.7.9 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.10 In approximately 17 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (NBDY) Position +00001.

6.2.16.7.11 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.12 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT, record R1 and R2 (X PIPAS) Position +00001. Row 1 is whole part, Row 2 is fractional part, Units are cm/sec.

6.2.16.7.13 On K-148 enter the following sequence:

9702

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6.2.16.7.13 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.2.16.7.14 On CRT DSKY displays, verify R1 = +00900, R2 = +00000, and R3 = +00002.

If values for R1, R2 and R3 are correct, proceed to next step.
If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00002 ENTR (Test Position Entry)

6.2.16.7.16 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.16 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (+NBDZ) Position +00002.

6.2.16.7.17 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.18 In approximately 90 secs. VERB 06 NOUN 66 shall flash. From the CRT, record R1 and R2 (-X PIPAG) Position +00002.

6.2.16.7.19 On K-148 enter the following sequence:

VERB 21 NOUN 01 ENTR
00407 ENTR
77757 ENTR
VERB 21 NOUN 01 ENTR
00411 ENTR
00020 ENTR
VERB 33 ENTR

6.2.16.7.20 In approximately 67 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (-NBDX + ADIAX) Pos +00002, Record CRT CDU gimbal angle indications and time.

6.2.16.7.21 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

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6.2.16.7.22 On CRT, DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00003.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00003 ENTR (Test Position Entry)

6.2.16.7.23 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.24 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (-NBDX) Position +00003.

6.2.16.7.25 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.26 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R1 and R2 (+Z PIPAG) Position +00003.

6.2.16.7.27 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.2.16.7.28 On the CRT, DSKY display verify R1 = +00900, R2 = 00000, and R3 = +00004.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00004 ENTR (Test Position Entry)

6.2.16.7.29 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.30 In approximately 17 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (+NBDY +ADSRAY) Position +00004.

6.2.16.7.31 On K-148 enter the following sequence:

VERB 33 ENTR

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- 6.2.16.7.32 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R1 and R2 (~Z PIPAG) Position +00004.
- 6.2.16.7.33 On K-148 enter the following sequence:
- VERB 21 NOUN 01 ENTR
00405 ENTR
00020 ENTR
VERB 21 NOUN 01 ENTR
00407 ENTR
77757 ENTR
VERB 33 ENTR
- 6.2.16.7.34 In approximately 67 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R2 (+NBDZ + ADIAZ) Position +00004. Record CRT CDU gimbal angle indications and time.
- 6.2.16.7.35 On K-148 enter the following sequence:
- VERB 33 ENTR
VERB 06 NOUN 66 shall flash
- 6.2.16.7.36 From the CRT DSKY display, verify R1 = +00900, R2 = +00000 and R3 = +00005.
- If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:
- VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00005 ENTR (Test Position Entry)
- 6.2.16.7.37 On K-148 enter the following sequence:
- VERB 33 ENTR
- 6.2.16.7.38 The PROG alarm and GIMBAL LOCK lamps shall light. Press Error Reset. The PROG alarm lamp shall extinguish.
- 6.2.16.7.39 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R1 and R2 (+Y PIPAG) Position +00005.
- 6.2.16.7.40 On K-148 enter the following sequence:
- VERB 34 ENTR
VERB 06 NOUN 66 shall flash
- 6.2.16.7.41 On K-148 enter the following sequence:
- VERB 34 ENTR
VERB 06 NOUN 66 shall flash

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FORM 34. ENTR
VERB 06 NOUN 66 shall flash

- 6.2.16.7.41 On the CRT DSKY display, verify R1 = +00900, R2 = +00000 and R3 = +00006.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2, and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00006 ENTR (Test Position Entry)

- 6.2.16.7.42 On K-148 enter the following sequence:

VERB 33 ENTR

- 6.2.16.7.43 The PROG alarm and GIMBAL LOCK lamps shall light. Press Error Reset. The PROG alarm lamp shall extinguish.

- 6.2.16.7.44 In approximately 90 secs VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R1 and R2. (-Y PIPAG) Position +00006.

- 6.2.16.7.45 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

- 6.2.16.7.46 On the CRT DSKY display, verify R1 = +00900, R2 = +00000 and R3 = +00007.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2, and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00007 ENTR (Test Position Entry)

- 6.2.16.7.47 On K-148 enter the following sequence:

VERB 33 ENTR

- 6.2.16.7.48 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (+.707 ADSRAX-NBDX) Position +00007.

- 6.2.16.7.49 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

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- 6.2.16.7.50 On the CRT DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00008.
- 6.2.16.7.51 On K-148 enter the following sequence:
- VERB 33 ENTR
- 6.2.16.7.52 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 $\left[\begin{array}{l} - .707 \text{ (NBDZ+NBDY)} \\ +0.5 \text{ (ADIAZ-ADIAZ)} \end{array} \right] +0.5 \text{ (ADSRAY + ADSRAZ)} \text{ Position +00008.}$
- 6.2.16.7.53 On K-148 enter the following:
- VERB 34 ENTR
VERB 06 NOUN 66 shall flash
- 6.2.16.7.54 On the CRT DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00009.
- If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:
- VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00009 ENTR (Test Position Entry)
- 6.2.16.7.55 On K-148 enter the following sequence:
- VERB 33 ENTR
- 6.2.16.7.56 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 $\text{(-NBDZ + .707 ADSRAZ)} \text{ Position +00009.}$
- 6.2.16.7.57 On K-148 enter the following sequence:
- VERB 34 ENTR
VERB 06 NOUN 66 shall flash
- 6.2.16.7.58 On the CRT DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00010.
- If values for R1, R2, and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:
- VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00010 ENTR (Test Position Entry)

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6.2.16.7.59 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.60 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R2 [707 (NBDY-NBDX) +.5 (ADIAY-ADIAX) +.5 ADSRA ☒ Position +00010.

6.2.16.7.61 Terminate this test by entering in K-148 the following:

VERB 36 ENTR

6.2.16.7.62 On K-148 enter the following sequence:

VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR

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6.2.16.10 Calculations

Table XXI

Position No. As Displayed in R3	Quantity Being Measured
+00001	+HEUY +X PIPA G
+00002	+HEOZ -X PIPA G -HEBK + ADIAX
+00003	-HEBK +E PIPA G
+00004	+HEUY + ADERAY -Z PIPA G +HEOZ + ADIAZ
+00005	+ Y PIPA G
+00006	- Y PIPA G
+00007	-HEBK + .707 ADERAX
+00008	.707 (-HEBK - HEUY) + .5 (ADIAZ - ADIAX) +.5 (ADERAY + ADERAZ)
+00009	-HEBK + .707 ADERAZ
+00010	.707 (HEUY - HEBK) + .5 (ADIAX - ADIAX) +.5 (ADERAX)

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6.2.16.10.1 Measured Values

	Line	Position No.	Step No.	Parameter	Recorded Value
6.2.16.10.1.1	1	+00001	6.2.16.7.10	+NBDY	R2
6.2.16.10.1.2	2	+00001	6.2.16.7.10	+XPIPAG	R1 . R2
6.2.16.10.1.3	3	+00002	6.2.16.7.10	+NBDZ	R2
6.2.16.10.1.4	4	+00002	6.2.16.7.10	-XPIPAG	R1 . R2
6.2.16.10.1.5	5	+00002	6.2.16.7.20	-NBDX + ADIAZ	R2
6.2.16.10.1.6	6	+00003	6.2.16.7.20	-NBDX	R2
6.2.16.10.1.7	7	+00003	6.2.16.7.20	+ZPIPAG	R1 . R2
6.2.16.10.1.8	8	+00004	6.2.16.7.20	+NBDY + ADGRAY	R2
6.2.16.10.1.9	9	+00004	6.2.16.7.20	-ZPIPAG	R1 . R2
6.2.16.10.1.10	10	+00004	6.2.16.7.20	+NBDZ + ADIAZ	R2
6.2.16.10.1.11	11	+00005	6.2.16.7.20	+YPIPAG	R1 . R2
6.2.16.10.1.12	12	+00006	6.2.16.7.20	-YPIPAG	R1 . R2
6.2.16.10.1.13	13	+00007	6.2.16.7.20	-NBDX + .707ADGRAZ	R2
6.2.16.10.1.14	14	+00008	6.2.16.7.20	.707 (-NBDZ - NBDY) + .5 (ADIAZ - ADIAY) + .5 (ADGRAY + ADGRAZ)	R2
6.2.16.10.1.15	15	+00009	6.2.16.7.20	-NBDZ + .707ADGRAZ	R2
6.2.16.10.1.16	16	+00010	6.2.16.7.20	.707(NBDY - NBDX) + .5 (ADIAY - ADIAZ) + .5 ADGRAZ	R2

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6.2.16.10.2 Obtain data from last historical IRIG and PIPA test and complete Table X₁₋₁.

TABLE X₁₋₁

PARAMETER	UNITS	RECORDED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIAX	meru/g	
ADIAZ	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

6.2.16.10.3 Obtain data from the second last historical IRIG and PIPA test and complete Table X₁₋₂.

TABLE X₁₋₂

PARAMETER	UNITS	RECORDED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIAX	meru/g	

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TABLE X₁₋₂ (Continued)

PARAMETER	UNITS	RECORDED VALUE
ADIA Y	meru/g	
ADIA Z	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

6.2.16.10.4 Obtain data from the third last historical IRIG and PIPA test and complete Table X₁₋₃.

TABLE X₁₋₃

PARAMETER	UNITS	RECORDED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIA X	meru/g	
ADIA Y	meru/g	
ADIA Z	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

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6.2.16.10.5 Compute the PIPA Scale Factor error in parts per million and record in Table X.

a. PIPA S. F. Error = $\left[\frac{(2 \text{ local g})}{+PIPAG - (-PIPAG)} - 1.000000 \right] 10^6$

b. X PIPA S. F. Error = $\left[\frac{(2 \text{ local g})}{\text{line 2} - \text{line 4}} - 1.000000 \right] 10^6$

c. Y PIPA S. F. Error = $\left[\frac{(2 \text{ local g})}{\text{line 11} - \text{line 12}} - 1.000000 \right] 10^6$

d. Z PIPA S. F. Error = $\left[\frac{(2 \text{ local g})}{\text{line 7} - \text{line 9}} - 1.000000 \right] 10^6$

The PIPA S. F. Error shall not exceed ± 1900 PPM.

6.2.16.10.6 Compute the PIPA Bias in cm/sec^2 and record in Table X₁.

a. PIPA Bias = $\frac{+PIPAG + (-PIPAG)}{2} = \text{--- cm/sec}^2$

b. X PIPA Bias = $\frac{\text{line 2} + \text{line 4}}{2} =$

c. Y PIPA Bias = $\frac{\text{line 11} + \text{line 12}}{2} =$

d. Z PIPA Bias = $\frac{\text{line 7} + \text{line 9}}{2} =$

The PIPA Bias shall not exceed $\pm 2.28 \text{ cm/sec}^2$.

6.2.16.10.7 Calculate NBD, ADSRA, and ADIA and record in Table X₁.

a. NBDX = $-(\text{line 6}) =$
NBDY = line 1 =
NBDZ = line 3 =
NBD shall not exceed $\pm 15 \text{ meru}$.

b. ADSRAX = $\frac{(\text{line 13} - \text{line 6})}{.707} =$

ADSRAY = line 8 - line 1 =

ADSRZ = $\frac{\text{line 15} + \text{line 3}}{.707} =$

ADSR shall not exceed $\pm 40 \text{ meru/g}$.

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c. ADIAX = line 5 - line 6 =

$$ADIA Y = \frac{\text{line 16} - .707 (\text{NBDY} - \text{NBDX}) - .5 (\text{ADSRAX} - \text{ADIAX})}{.5}$$

ADIAZ = line 10 - line 3 =

ADIA shall not exceed ± 100 meru/g.

TABLE X₁

PARAMETER	UNITS	CALCULATED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIAX	meru/g	
ADIA Y	meru/g	
ADIAZ	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

6.2.16.10.8 Perform the following calculations for each term in Table X₁, and record the results in Table D.

$$D_1 = |X_{i-1} - X_i|$$

$$D_2 = |X_{i-1} - X_i| + |X_{i-2} - X_{i-1}|$$

$$D_3 = |X_{i-3} - X_{i-2}| + |X_{i-2} - X_{i-1}| + |X_{i-1} - X_i|$$

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X_1 = data point just obtained
 X_{1-1} = last historical data point
 X_{1-2} = second last historical data point
 X_{1-3} = third last historical data point

NOTE: D_1 calculations begin with the first data point after ISS Pre-Vib; D_2 calculations begin with the second data point after ISS Pre-Vib; D_3 calculations begin with the third data point after Pre-Vib.

TABLE D

PARAMETER	UNITS	D_1	MAX	D_2	MAX	D_3	MAX
NBDX	meru		6		9		11
NBDY	meru		6		9		11
NBDZ	meru		6		9		11
ADSRAX	meru/g		14		21		25
ADSRAY	meru/g		14		21		25
ADSRAZ	meru/g		14		21		25
ADIAX	meru/g		17		33		40
ADIA Y	meru/g		17		33		40
ADIAZ	meru/g		17		33		40
X PIPA S. F. Error	PPM		400		500		600
Y PIPA S. F. Error	PPM		400		500		600
Z PIPA S. F. Error	PPM		400		500		600
X PIPA Bias	cm/sec ²		0.5		0.7		0.9
Y PIPA Bias	cm/sec ²		0.5		0.7		0.9
Z PIPA Bias	cm/sec ²		0.5		0.7		0.9

6.2.16.10.9 Failure to meet the above criteria shall result in retest according to paragraph 5.4.2.

6.2.17 SXT-NB-IMU Fine Alignment Test

6.2.17.1 Perform Master Initialization 6.2.5.3 before proceeding.

6.2.17.2 Prior to performing this test, the G&N Installation Qualification fixture shall be installed on the supporting fixture and adjusted to permit proper operation of the G&N optics. The azimuth supplied by the azimuth autaset (Optical Reference No. 1) shall be known to ± 30 minutes of arc.

NOTE: The G&N shall have had OPERATE power applied for a minimum of 1 hour. Set the G/N POWER-OPTICS switch to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0 \pm 3.0 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.

6.2.17.3 Enter VERB 01 NOUN 10 into KI48. Press the ENTER pushbutton. Enter 00003 into KI48. Press the ENTER pushbutton. Record R1 = AAAAA.

If the recorded value is within any of the sets of limits given in Table 1 proceed with the test. If the recorded value is NOT within any of the sets of limits wait 30 minutes and then repeat this step.

TABLE I

MIN VALUE			MAX VALUE
00000	<	AAAAA	< 03242
04000	<	AAAAA	< 07242
10000	<	AAAAA	< 13242
14000	<	AAAAA	< 17242
20000	<	AAAAA	< 23242
24000	<	AAAAA	< 27242
30000	<	AAAAA	< 33242
34000	<	AAAAA	< 37242

6.2.17.4 Enter the following sequence into the Lower Equipment Bay (LEB) DSKY.

- a. VERB 41 NOUN 20 ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.17.5 On the G&N Indicator Control Panel set the following switches to the position indicated.

- a. OPTICS TEL TRUN to SLAVE to SXT
- b. OPTICS COUPLING to DIRECT
- c. OPTICS SPEED to LO
- d. OPTICS MODE to MAN

6.2.17.5.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC. Set OPTICS ZERO to ZERO.

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6.2.17.6 Enter the following into the DSKY:

- a. VERB 01 NOUN 01, ENTER
- b. 00362, ENTER
- Record R1 = XXXXY

6.2.17.7 Enter the following into the DSKY

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table II and XXXX is that recorded in 6.2.17.9.

TABLE II

Y (From 6.2.17.9)	0	1	2	3	4	5	6	7
Y'	2	3	2	2	6	7	6	7

6.2.17.8 Initiate the test by entering the following sequence into the LEB DSKY.

- a. VERB 57, ENTER
- b. 00003, ENTER

6.2.17.9 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data is displayed in R1 and R2 on the DSKY.

- a. R1 = +13500
- b. R2 = +xx.xxx (Site Latitude from Table I)

TABLE I

Test Site	Latitude
NAA	+33.923
MILA	+28.516
MSC	+29.556

6.2.17.10 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If the value displayed is other than +13500 in R1 and the correct Site Latitude in R2, correct the data by entering the following sequence into the DSKY.

- a. VERB 21, ENTER
- b. +13500, ENTER
- c. VERB 22, ENTER
- d. +xx.xxx, ENTER (+xx.xxx = Site Latitude from Table I)
- e. VERB 33, ENTER

6.2.17.11 Observe VERB 21 NOUN 30 flashing on the DSKY. Enter the following sequence into the DSKY.

- a. +00001, ENTER (Position Number)
- b. +00000, ENTER
- c. +00001, ENTER

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- 6.2.17.12 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Y_{NB} Azimuth)
 - R2 = +xx.xxx (Y_{NB} Elevation)
 - R3 = 00001
- 6.2.17.13 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct YNB azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx ± 002.00 degrees, ENTER (Y_{NB} azimuth)
 - +xx.xxx ± 02.000 degrees, ENTER (Y_{NB} elevation)
 - VERB 33, ENTER
- 6.2.17.14 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Z_{NB} Azimuth)
 - R2 = +xx.xxx (Z_{NB} Elevation)
 - R3 = 00002
- 6.2.17.15 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct ZNB azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx ± 002.00 degrees, ENTER (Z_{NB} Azimuth)
 - +xx.xxx ± 02.000 degrees, ENTER (Z_{NB} elevation)
 - VERB 33, ENTER
- 6.2.17.16 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Target 1 Azimuth)
 - R2 = +xx.xxx (Target 1 Elevation)
 - R3 = 00001
- 6.2.17.17 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct azimuth and elevation for Target 1, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx ± 000.10 degrees, ENTER (Target 1 Azimuth)
 - +xx.xxx ± 00.010 degrees, ENTER (Target 1 Elevation)
 - VERB 33, ENTER
- 6.2.17.18 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Target 2 Azimuth)
 - R2 = +xx.xxx (Target 2 Elevation)
 - R3 = 00002

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- 6.2.17.19 If the data displayed is correct proceed to 6.2.17.20. If R1 and R2 do not contain the correct azimuth and elevation for Target 2, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - XXXX.XXX000.10 degrees, ENTER (Target 2 Azimuth)
 - XXX.XXX00.010 degrees, ENTER (Target 2 Elevation)
- 6.2.17.20 Set the OPTICS ZERO switch to OFF. Enter VERB 33, ENTER into the DSKY.
- 6.2.17.21 When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00001, set the OPTICS MODE switch on the G&N Indicator Control Panel to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.
- 6.2.17.22 Using the Optics Band Controller, align the SXT StLOS with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.23 When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00002 set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.
- 6.2.17.24 Using the Optics Hand Controller, align the SXT StLOS with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.
- NOTE: The following two MARKS must be performed as quickly as possible. In no case shall the time between the first and second MARK exceed two minutes.
- 6.2.17.25 After 90 seconds observe the DSKY for VERB 51 NOUN 30 flashing and R1 = 00001. Set the Optics Mode switch to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.
- 6.2.17.26 Using the Optics Hand Controller, align the SXT StLOS with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.

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- 6.2.17.27 When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00002 set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.
- 6.2.17.28 Using the Optics Hand Controller, align the SXT StLOS with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.29 Repeat steps 6.2.17.26 through 6.2.17.28.
- 6.2.17.29 In approximately 7 minutes VERB 06 NOUN 66 shall flash on the DSKY and the test results shall be displayed. R1 and R2 on the DSKY shall display the misalignment of one of the horizontal PIPA's in arc seconds (R1 = whole, R2 = fractional). Record R1 and R2. (See Table II for PIPA displayed).
- 6.2.17.30 Enter VERB 33 ENTER into the DSKY. When VERB 06 NOUN 66 flashes, R1 and R2 on the DSKY shall display the misalignment of the second horizontal PIPA in arc seconds (R1 whole, R2 fractional). (See Table II for PIPA displayed.) Record R1 and R2.
- 6.2.17.31 Enter VERB 34 ENTER into the DSKY to terminate the test. Wait 5 seconds.
- 6.2.17.32 Repeat steps 6.2.17.3 and 6.2.17.8 through 6.2.17.31 substituting No. 00002 in 6.2.17.11.a.
- 6.2.17.33 Enter the following into the DSKY.
- a. VERB 36, ENTER
 - b. VERB 41 NOUN 20, ENTER
 - c. +00000, ENTER
 - d. +00000, ENTER
 - e. +00000, ENTER

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Table II. Display Conditions at Test Completion

Position	SM Orientation			Horizontal Misalignment Component	
	X _{SM}	Y _{SM}	Z _{SM}	6.2.17.30	6.2.17.30
1	UP	SW	SE	Y _{SM}	Z _{SM}
2	SE	SW	DN	X _{SM}	Y _{SM}
3*	SE	UP	SW	X _{SM}	Z _{SM}

* Position 3 is not run in the Spacecraft because of GIMBAL LOCK considerations.

6.2.17.34 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.17.35 Calculations

- 6.2.17.35.1 a. Y_{SM} misalignment = () $\frac{R1 \cdot R2}{R1 \cdot R2}$
 b. Z_{SM} misalignment = () $\frac{R1 \cdot R2}{R1 \cdot R2}$
 c. X_{SM} misalignment = () $\frac{R1 \cdot R2}{R1 \cdot R2}$
 d. Y_{SM} misalignment = () $\frac{R1 \cdot R2}{R1 \cdot R2}$

6.2.17.35.2 Enter the latest values from 6.2.16 IMU Performance Test.

- a. X PIPA bias = _____ cm/sec²
 b. Y PIPA bias = _____ cm/sec²
 c. Z PIPA bias = _____ cm/sec²
 d. $\theta_x = 210$ (X PIPA bias) = _____ arc sec.
 e. $\theta_y = 210$ (Y PIPA bias) = _____ arc sec.
 f. $\theta_z = 210$ (Z PIPA bias) = _____ arc sec.

- 6.2.17.35.3 a. Y_{SM} misalignment (Bias corrected) = 6.2.17.35.1a - θ_y = _____ arc sec.
 b. Z_{SM} misalignment (Bias corrected) = 6.2.17.35.1b - θ_z = _____ arc sec.
 c. X_{SM} misalignment (Bias corrected) = 6.2.17.35.1c - θ_x = _____ arc sec.
 d. Y_{SM} misalignment (Bias corrected) = 6.2.17.35.1d - θ_y = _____ arc sec.

The SM misalignments in each orientation, including PIPA bias, shall not exceed ±150 arc seconds.

6.2.18 Gyrocompassing Test

NOTE: Perform Master Initialization 6.2.5.3 before proceeding.

6.2.18.1 Set the G/N POWER-OPTICS Switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Verify that OPTX 28V 800 cps 1% zero (CG1211) and OPTX 28V 800 cps 5%- 90°h (CG 1212) are not flashing on the CRT.

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6.2.18.2 Enter the following into the DSKY.

a. VERB 01 NOUN 01, ENTER

b. 00362, ENTER

Record R1 = XXXXY

6.2.18.3 Enter the following into the DSKY.

a. VERB 21 NOUN 01, ENTER

b. 00362, ENTER

c. XXXXY', ENTER where Y' is determined by Table II and XXXX is that recorded in 6.2.18.2.

Table II

Y (From 6.2.18.2)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.18.4 Enter the following sequence into the K-Start, pressing ENTER pushbutton after each entry.

a. VERB 57, ENTER

b. 00006, ENTER

6.2.18.5 System shall advance to Gyrocompass System Test and display 01 on the CRT program display.

6.2.18.6 On the CRT observe VERB 06, NOUN 61 flashing with some launch azimuth displayed in R1 = +XXX.XX.

6.2.18.6.1 If the azimuth displayed is correct proceed to 6.2.18.5; if not, perform the following sequence:

a. VERB 21, Press ENTER pushbutton

b. +XXX.XX, press ENTER pushbutton (Correct Launch Azimuth)

6.2.18.7 After verifying that the correct launch azimuth is displayed in R1 on the CRT, Enter VERB 33 on the K-START and push the ENTER pushbutton.

6.2.18.8 Observe VERB 06 NOUN 61 flashing on the CRT with the following displayed in R1 and R2.

a. R1 = +XXX.XX, Nav. Base Azimuth (ZNB)

b. R2 = +XX.XXX, Site Latitude

6.2.18.8.1 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence:

To correct R1:

a. VERB 21, ENTER

b. +XXX.XX+000.50 degrees, ENTER (ZNB Azimuth)

To correct R2:

a. Verb 22, ENTER

b. +XX.XXX, ENTER (Correct Site Latitude from Table I)

- 6.2.18.0.1 *Test procedure for G&N Indicator Control Panel (ICP) OPTICS ZERO switch setting. Carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the SXT Trunnion to within +5 degrees of zero as indicated by the SXT Trunnion to within +5 degrees of zero.*
- 6.2.18.9 Gyrocompassing Stability
- 6.2.18.9.1 Enter VERB 33, ENTER into the DSKY. On the DSKY observe the PROGRAM display change to 05 after approximately 90 seconds. Approximately 5 minutes later observe the PROGRAM display change to 02. When PROG display changes to 02 record time as T_0 .
- 6.2.18.9.2 120 minutes after T_0 record the Outer, Inner and Middle CDU Gimbal angles from the CRT.
- 6.2.18.9.3 Repeat above step every 5 minutes for the next 60 minutes.
- 6.2.18.9.4 The peak-to-peak spread of the outer gimbal angle shall not exceed 0.12 degrees.
- 6.2.18.9.5 The peak-to-peak spread of the Inner and Middle gimbal angles shall not exceed 0.06 degrees.
- 6.2.18.10 Gyrocompassing Accuracy
- 6.2.18.10.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Between 175 minutes and 180 minutes from T_0 set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.10.2 Enter the following into the DSKY.
- a. VERB 21 NOUN 03 ENTER
 - b. 02663 ENTER
 - c. +XXX.XX±000.01 ENTER (Target No. 1 Az)
 - d. Press ENTER Pushbutton
 - e. 02664 ENTER
 - f. +XXX.XX±000.01 ENTER (Target No. 2 Az)
 - g. Press ENTER Pushbutton
 - h. 02665 ENTER
 - i. +00.000 ENTER (Target No. 1 EL)
 - j. Press ENTER Pushbutton
 - k. 02666 ENTER
 - l. +00.000 ENTER (Target No. 2 EL)
- On the G&N Indicator Control Panel set the OPTICS ZERO switch to OFF, set the OPTICS MODE switch to MAN and the OPTICS SPEED switch to HI. Drive the StLOS to the approximate position of Target No. 1. Set the OPTICS SPEED Switch to LO.
- NOTE: Read the following 10 steps before proceeding. These are time critical steps and must be performed as rapidly as possible.
- 6.2.18.11 After 180 minutes from T_0 enter VERB 52 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT change to 03.

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- 6.2.18.12 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 1 azimuth and elevation.
- R1 = +xxx.xx (Target 1 azimuth)
 - R2 = +00.000 (Target 1 elevation)
- 6.2.18.13 Verify the data appearing in R1 and R2 and if correct, proceed. If not correct, perform the following sequence.
- VERB 24, ENTER
 - +xxx.xx±000.01, ENTER (Target 1 azimuth)
 - +00.000, ENTER (Target 1 elevation)
- 6.2.18.14 After the correct readings for R1 and R2 are verified, enter VERB 33 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.15 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 2 azimuth and elevation.
- R1 = +xxx.xx (Target 2 azimuth)
 - R2 = +00.000 (Target 2 elevation)
- 6.2.18.16 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence.
- VERB 24, ENTER
 - +xxx.xx±000.01, ENTER (Target 2 azimuth)
 - +00.000, ENTER (Target 2 elevation)

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- 6.2.18.17 After the correct readings for R1 and R2 are verified enter VERB 33 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.18 Using the Optics Hand Controller, align the SXT StLOS to target 1 and press the MARK pushbutton. If satisfied that the MARK was good, proceed. If not satisfied with MARK, press the MARK REJECT pushbutton and repeat the step.
- 6.2.18.19 Set the OPTICS SPEED switch to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target No. 2.
- 6.2.18.20 Set the OPTICS SPEED switch to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 2 and press the MARK pushbutton. If satisfied that the MARK was good, press the ENTER pushbutton. If not satisfied, press the MARK REJECT pushbutton and repeat this step.
- 6.2.18.21 On the CRT observe the following data displayed:
- a. VERB 06 NOUN 60
 - b. R1 = ±xx.xxx (X gyro elevation error, degrees)
 - c. R2 = ±xx.xxx (Y gyro elevation error, degrees)
 - d. R3 = ±xx.xxx (Z gyro azimuth error, degrees)
- Record R1, R2 and R3.
- 6.2.18.22 Enter VERB 34 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT and DSKY's indicate 02. Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT)...Set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.23 Enter VERB 34 NOUN 20 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.23 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.24 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start three times. Press the ENTER pushbutton after each entry. Set the G/N POWER OPTICS Switch on the LEB Lighting Control Panel to OFF.

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6.2.18.25 Data Sheet

TIME	CDUX	CDUY	CDUZ
To			
To +15			
To +30			
To +45			
To +60			
To +75			
To +90			
To +105			
To +120			
To +125			
To +130			
To +135			
To +140			
To +145			
To +150			
To +155			
To +160			
To +165			
To +170			
To +175			
To +180			

- NOTES: 1. Record CDU angles at times indicated. (T_0 is the time at the start of test - Prog 02)
2. The 2 hr data ($T_0 + 120$ minutes) is baseline.

Tolerance: Tolerance is $0.00 \pm 0.06^\circ$ delta from 2 hr baseline for CDUX, and $0.00 \pm 0.03^\circ$ delta from 2 hr baseline for CDUY & CDUZ for the 120 minute to 180 minute recordings only.

Line	Step	Parameter	Recorded Value
1	6.2.18.21	X Gyro Elevation Error	$\pm R1$ degrees
2		Y Gyro Elevation Error	$\pm R2$ degrees
3		Z Gyro Azimuth Error	$\pm R3$ degrees

6.2.18.26 Calculation Sheet

6.2.18.26.1 Record the most recent values of the following coefficients from 6.2.16, IMU Performance Test.

- a. NBDX = () _____
- b. NBDY = () _____
- c. NBDZ = () _____
- d. ADIAZ = () _____
- e. ADSRAY = () _____

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6.2.18.26.2 Perform the following calculations. (Cos λ functions are provided in Table I.)

a. $D_{(vert)} = NBDZ + ADIAZ$

$D_{(vert)} = () \text{ } \underline{\hspace{2cm}} \text{ meru}$

b. $D_{(east)} = \sin(\text{Launch Az}) NBDX + \cos(\text{Launch Az}) NBDY + ADSRAY$

c. $\phi_{(vert)} = \frac{D_{(vert)} \times \cos \lambda + D_{(east)} \times \frac{206}{3600}}{\cos \lambda}$

$\phi_{(vert)} = () \text{ } \underline{\hspace{2cm}} \text{ degrees}$

Table I

Location	Latitude λ	Cos λ
NAA	33.921	0.82985
MILA	28.516	0.87868
MSC	29.556	0.86993

6.2.18.26.3 Perform the following calculations using the recorded data from 6.2.18.25 and 6.2.18.26.2.

a. Z Gyro azimuth error 3 hrs (corrected) = line 3 - $\phi_{(vert)}$
Z Gyro azimuth error 3 hrs (corrected) = $\underline{\hspace{2cm}}$ corrected
Z Gyro azimuth error (corrected) shall be 0.00 \pm 0.573 degrees.

b. X Gyro elevation error (3 hr) = line 1 $\underline{\hspace{2cm}}$
X Gyro elevation error (3 hr) = $\underline{\hspace{2cm}}$ degrees

c. Y Gyro elevation error (3 hr) = line 2 $\underline{\hspace{2cm}}$
Y Gyro elevation error (3 hr) = $\underline{\hspace{2cm}}$ degrees
The X and Y Gyro elevation errors shall be 0.00 \pm 0.045 degrees.

6.2.19 CMC Voltage Margin Test

6.2.19.1 Verify that the G&N IMU HTR MNA and MNB breakers are engaged, computer MNA and MNB breakers are engaged, IMU MNA and MNB breakers are not engaged, and the G&N Power-IMU switch on the LEB Lighting Control Panel is in the OFF position. On K-148, enter VERB 36 ENTR.

6.2.19.2 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to ON.

CAUTION: During the performance of this test the +4 VDC CMC Power Supply shall not be operated at less than +2.5 VDC or greater than 5.2 VDC (CG 1030). The +14 VDC CMC Power Supply shall not be operated at less than +8.5 VDC or greater than +17.0 VDC (CG 1020). Rotate the LEB LTS NUMERICS SEL to approximately center position. Decrease to absolute minimum

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6.2.19.2 discernible lighting.
(cont)

NOTE: The flashing indication of the CMC Power Supplies on CRT may be disregarded for this test. The charts in Table I may be used to determine approximate values for the "XX.X" values of C-156 voltage dial settings corresponding to various power supply voltages.

6.2.19.2.1 Into R-153, insert 1100. Verify and execute.

6.2.19.3 Units R-154, insert 0001. Verify and execute.

6.2.19.4 Insert in C-156, -040001244 and execute. Verify on CRT that GV0116 is between -3.0 and -5.0 vdc.

6.2.19.5 Insert in C-156 -050001234 and execute. Verify on CRT that GV0106 is between -4.0 and -6.0 vdc.

6.2.19.6 Units R-154, insert 0111. Verify and execute.

6.2.19.7 Observe CG 1020, +14 VDC Power Supply, and CG 1030, +4 VDC Power Supply on CRT. Repeat 6.2.19.3 through 6.2.19.6 adjusting each C Start entry until CG 1020 is 12.1, +0.1, -0.0 vdc and CG 1030 is 3.40, +0.03, -0.00 vdc.

6.2.19.8 Initiate CMC Self Check by inserting the following in K-148.

- a. ERROR RESET
- b. VERB 21, NOUN 27, ENTER
- c. 77777, ENTER

Wait 200 seconds.

6.2.19.9 Insure that the DSKY RESTART lamp does not light, and that

- a. VERB 05 NOUN 31
 - b. R1 = 01102
- does not appear on DSKY.

6.2.19.9.1 Into R-154, insert 0101. Verify and execute.

6.2.19.10 Set INHIBIT VOLTAGE FAIL switch to OFF on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. If RESTART lamp does not light, repeat 6.2.19.3. Verify CMC Warning master alarms are lighted.

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- 6.2.19.11 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
a. ERROR RESET
b. VERB 21, NOUN 27, ENTER
c. 77777, ENTER
- 6.2.19.12 Units R-154, insert 0001. Verify and execute.
- 6.2.19.13 Insert in C-156 +108001244 and execute. Verify on CRT that GV0116 is between +0.8 and +11.8 vdc.
- 6.2.19.14 Units R-154, insert 0111. Verify and execute.
- 6.2.19.15 Observe CG 1020, +14 VDC Power Supply on CRT. Repeat 6.2.19.12 through 6.2.19.14 adjusting the C Start entry until CG 1020 is 16.4, +0.0, -0.1 vdc.
- 6.2.19.16 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
a. VERB 05, NOUN 31
b. R1 = 01102
does not appear on DSKY
- 6.2.19.16.1 Into R-154, insert 0011. Verify and execute.
- 6.2.19.17 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted. ~~When 6.2.19.17 measuring CG 1020 and CG 1030 at PSAAM interface master of CRT.~~
- 6.2.19.18 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
a. ERROR RESET
b. VERB 21, NOUN 27, ENTER
c. 77777, ENTER
- 6.2.19.19 Units R-154, insert 0001. Verify and execute.
- 6.2.19.20 Insert in C-156, +092001234 and execute. Verify on CRT that GV0106 is between +0.2 and +10.2 vdc.
- 6.2.19.21 Units R-154, insert 0111. Verify and execute.
- 6.2.19.22 Observe CG 1030, +4 VDC Power Supply on CRT. Repeat 6.2.19.19 through 6.2.19.21 adjusting the C Start entry until CG 1030 is 4.60, +0.00, -0.03 vdc.
- 6.2.19.23 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
a. VERB 05, NOUN 31
b. R1=01102
does not appear on DSKY.
- 6.2.19.23.1 Into R-154, insert 0101. Verify and execute.

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- 6.2.19.24 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted. ~~Insert into 6.2.19.24 measuring CG 1020 and CG 1030 on PSAAM indicator instead of CRT.~~
- 6.2.19.25 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- a. ERROR RESET
 - b. VERB 21, NOUN 27, ENTER
 - c. 77777, ENTER.
- 6.2.19.26 Units R-154, insert 0001. Verify and execute.
- 6.2.19.27 Insert in C-156, -040001244 and execute. Verify on CRT that GV0116 is between -3.0 and -5.0 vdc.
- 6.2.19.28 Units R-154, insert 0111. Verify and execute.
- 6.2.19.29 Observe CG 1020, +14 VDC Power Supply on CRT. Repeat 6.2.19.26 through 6.2.19.28 adjusting the C Start entry until CG 1020 is 12.1, ± 0.1 , -0.0 vdc.
- 6.2.19.30 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- a. VERB 05, NOUN 31
 - b. R1 = 01102
- does not appear on DSKY.
- 6.2.19.30.1 Into R-154, insert 0011. Verify and execute.
- 6.2.19.31 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted. ~~Insert into 6.2.19.31 measuring CG 1020 and CG 1030 on PSAAM indicator instead of CRT.~~
- 6.2.19.32 Units R-154, insert 0000. Verify and execute.
- 6.2.19.33 Terminate CMC Self-Check by inserting into K-148:
- a. ERROR RESET
 - b. VERB 21, NOUN 27, ENTER
 - c. 00000, ENTER
- 6.2.19.34 Ensure that CG 1020, +14 VDC Power Supply indication is +14.0, ± 0.4 , and that CG 1030, +4 VDC Power Supply indication is +4.00 ± 0.20 VDC on CRT.

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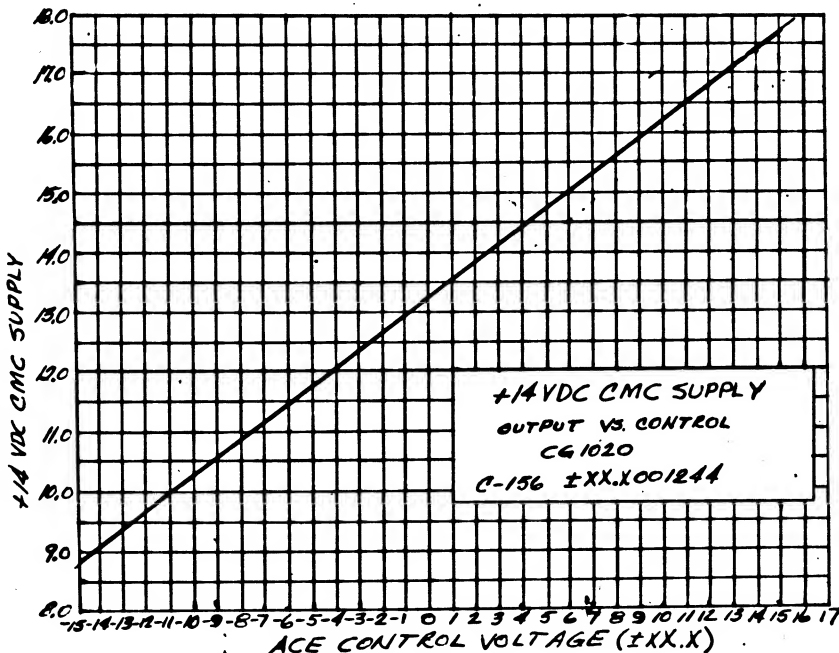
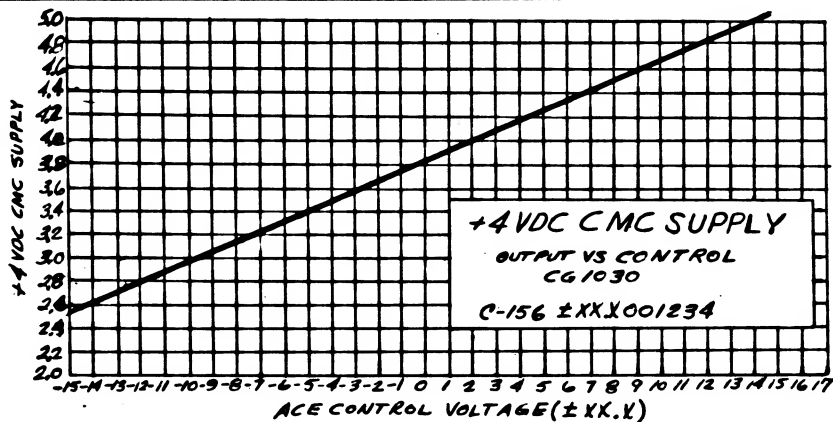


TABLE I

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6.2.20 Spacecraft Control and Displays Test

6.2.20.1 Discard this test if a Critical In-Flight Test of 6.2.2 and

6.2.20.2 Perform Master Initialization before proceeding. If system operation is not satisfactory, perform complete test before proceeding.

6.2.20.2 FDAI Attitude Error

6.2.20.2.1 Insert in KL48

- a. V 57 ENTER
- b. 00013 ENTER

6.2.20.2.2 Observe on CRT

- a. V 99 NO1 Flashing
- b. PROG 07
- c. NO ATT ON
- d. R1, R2, and R3 Approx. 00000

6.2.20.2.3 Insert in KL48

- a. VERB 33, ENTER

6.2.20.2.4 Observe on CRT

- a. V 99 NO1 Flashing
- b. R1 +00385
- c. R2 -00385
- d. R3 +00385
- e. NO ATT OFF

6.2.20.2.5 Record CRT indications

- a. CG 2279 ROLL ATT ERROR - CDU DAC OUT +148.00±0.50 VERMS
- b. CG 2219 PITCH ATT ERROR - CDU DAC OUT -148.00±0.50 VERMS
- c. CG 2249 YAW ATT ERROR - CDU DAC OUT +5.00±0.50 VERMS

6.2.20.2.6 Insert in KL48

- a. VERB 33, ENTER

6.2.20.2.7 Observe on CRT

- a. V 99 NO1 Flashing
- b. R1 +00384
- c. R2 -00384
- d. R3 +00384

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6.2.20.2.8 Record CRT indications

- | | | |
|------------|-------------------------------|--------------------------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | +5.06±0.66 VRMS ^{sec} |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | -8.06±0.66 VRMS ^{sec} |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | +8.06±0.66 VRMS ^{sec} |

6.2.20.2.9 Insert in KI48

- a. VERB 33, ENTER

6.2.20.2.10 Observe on CRT

- | | | |
|---------|-----|----------|
| a. V 06 | NO1 | Flashing |
| b. R1 | | +00160 |
| c. R2 | | -00160 |
| d. R3 | | +00160 |

6.2.20.2.11 Record CRT indications

- | | | |
|------------|-------------------------------|--------------------------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | +4.11±0.27 VRMS ^{sec} |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +4.11±0.27 VRMS ^{sec} |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | +2.11±0.27 VRMS ^{sec} |

6.2.20.2.12 Insert in KI48

- a. VERB 33, ENTER

6.2.20.2.13 Observe on CRT

- | | | |
|---------|-----|----------|
| a. V 06 | NO1 | Flashing |
| b. R1 | | +00135 |
| c. R2 | | -00135 |
| d. R3 | | +00135 |

6.2.20.2.14 Record CRT indications

- | | | |
|------------|-------------------------------|--------------------------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | +5.78±0.23 VRMS ^{sec} |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | -1.78±0.23 VRMS ^{sec} |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | +1.78±0.23 VRMS ^{sec} |

6.2.20.2.15 Insert in KI48

- a. VERB 33, ENTER

6.2.20.2.16 Observe on CRT

- | | | |
|---------|-----|----------|
| a. V 06 | NO1 | Flashing |
| b. R1 | | +00090 |
| c. R2 | | -00090 |
| d. R3 | | +00090 |

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6.2.20.2.17 Record CRT indications

- | | | |
|------------|-------------------------------|---------------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | +1.88±0.15 VERMS-es |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | -1.19±0.15 VERMS-es |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | +1.19±0.15 VERMS-es |

6.2.20.2.18 Insert in K148

- a. VERB 33, ENTER

6.2.20.2.19 Observe on CRT

- | | | |
|---------|-----|----------|
| a. V 06 | NOL | Flashing |
| b. R1 | | +00000 |
| c. R2 | | +00000 |
| d. R3 | | -00090 |

6.2.20.2.20 Record CRT indications

- | | | |
|------------|-------------------------------|---------------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | 0.00±0.05 VERMS-es |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | 0.00±0.05 VERMS-es |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | -1.19±0.15 VERMS-es |

6.2.20.2.21 Insert in K148

- a. VERB 33, ENTER

6.2.20.2.22 Observe on CRT

- | | | |
|---------|-----|----------|
| a. V 06 | NOL | Flashing |
| b. R1 | | -00090 |
| c. R2 | | +00090 |
| d. R3 | | -00135 |

6.2.20.2.23 Record CRT indications

- | | | |
|------------|-------------------------------|---------------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | -1.19±0.15 VERMS-es |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +1.19±0.15 VERMS-es |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | -1.78±0.23 VERMS-es |

6.2.20.2.24 Insert in K148

- a. VERB 33, ENTER

6.2.20.2.25 Observe on CRT

- | | | |
|---------|-----|----------|
| a. V 06 | NOL | Flashing |
| b. R1 | | -00135 |
| c. R2 | | +00135 |
| d. R3 | | -00160 |

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6.2.20.2.26 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-1.78±0.23 VRMS
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+1.78±0.23 VRMS
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	+2.11±0.27 VRMS

6.2.20.2.27 Insert in K148

a. VERB 33, ENTER

6.2.20.2.28 Observe on CRT

a. V 04	NO1	Flashing
b. R1		-00160
c. R2		+00160
d. R3		-00384

6.2.20.2.29 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-1.11±0.27 VRMS
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+1.11±0.27 VRMS
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-1.06±0.66 VRMS

6.2.20.2.30 Insert in K148

a. VERB 33, ENTER

6.2.20.2.31 Observe on CRT

a. V 04	NO1	Flashing
b. R1		-00384
c. R2		+00384
d. R3		-00385

6.2.20.2.32 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-1.06±0.66 VRMS
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+1.06±0.66 VRMS
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-1.06±0.66 VRMS

6.2.20.2.33 Insert in K148

a. VERB 33, ENTER

6.2.20.2.34 Observe on CRT

a. V 04	NO1	Flashing
b. R1		-00385
c. R2		+00385
d. R3		+00000

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6.2.20.2.35 Record CRT indications

- | | | | |
|------------|-------------------------------|-----------------|-----|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | -5.08±0.88 VRMS | pos |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +5.06±0.68 VRMS | pos |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | 0.00±0.06 VRMS | pos |

6.2.20.2.36 Insert in K148

- | | | |
|----------|-----|-------|
| a. V 21 | MO1 | ENTER |
| b. 02545 | | ENTER |
| c. 02837 | | ENTER |
| d. V 33 | | ENTER |

6.2.20.2.37 Observe on CRT

- | | | |
|-----------|-----|----------------------|
| a. V 95 | MO2 | Flashing |
| b. NO ATT | | ON |
| c. R1 | | +00000 approximately |
| d. R2 | | +00000 approximately |
| e. R3 | | +00000 approximately |

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6.2.20.3 TVC Test

6.2.20.3.1 The G/W Autopilot Control and SPS Ready discretes shall be applied to the G/W interface.

6.2.20.3.2 Set the OPTICS MODE selector on the Indicator Control panel to MAN. Set the OPTICS ZERO switch to OFF.

6.2.20.3.3 Insert in K148

a. VERB 33, ENTER

6.2.20.3.4 Observe on CRT

a. V 01	N 10	Flashing
b. R1		X7373
c. R3		00030

6.2.20.3.5 Insert in K148

a. V 33 ENTER

6.2.20.3.6 Observe on CRT

a. V 01	NOON 10	Flashing
b. R1		37777
c. R3		00031

6.2.20.3.7 Insert in K148

a. V 33 ENTER

6.2.20.3.8 Observe on CRT

a. V 06	N 02	Flashing
b. R1		+00385
c. R2		-00385
d. R3		+00003

6.2.20.3.9 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+16.88-18.12+1.00 VERMS
b. CG 3721	SHAFT CDU DAC OUTPUT	-16.88-18.12+1.00 VERMS

6.2.20.3.10 Insert in K148

a. VERB 33, ENTER

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6.2.20.3.11 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00384
c. R2		-00384
d. R3		+00003
e. NO ATT		OFF

6.2.20.3.12 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+10.12±1.00 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	-10.12±1.00 VRMS

6.2.20.3.13 Insert in K148

a. VERB 33, ENTER

6.2.20.3.14 Observe on CRT

a. V 06	N 03	Flashing
b. R1		+00160
c. R2		-00160
d. R3		+00003

6.2.20.3.15 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+4.23±0.42 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	-4.23±0.42 VRMS

6.2.20.3.16 Insert in K148

a. VERB 33, ENTER

6.2.20.3.17 Observe on CRT

a. Y 06	N 03	Flashing
b. R1		+00135
c. R2		-00135
d. R3		+00003

6.2.20.3.18 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+3.56±0.36 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	-3.56±0.36 VRMS

6.2.20.3.19 Insert in K148

a. VERB 33, ENTER

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6.2.20.3.20 Observe on CRT

a. V 06	N 02	Flashing
b. R1		+00090
c. R2		-00090
d. R3		+00003

6.2.20.3.21 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+0.00±0.24 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	-2.30±0.24 VRMS

6.2.20.3.22 Set the OPTICS SPEED Switch on the Indicator Control Panel to HL, 1
Flash to HL

6.2.20.3.23 Insert in K148

a. VERB 33, ENTER

6.2.20.3.24 Observe on CRT

a. V 06	N 02	Flashing
b. R1		+00000
c. R2		+00000
d. R3		+00003

6.2.20.3.25 While holding the Optics Hand Controller up and left (45°) no longer than 10 seconds, record CRT indications.

a. CG 3722	TRUNNION CDU DAC OUTPUT	0.00±0.12 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	00.00±0.12 VRMS

6.2.20.3.26 Insert in K148

a. VERB 33, ENTER

6.2.20.3.27 Observe on CRT

a. V 06	N 02	Flashing
b. R1		-00090
c. R2		+00090
d. R3		+00003

6.2.20.3.28 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-2.30±0.24 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	+2.00±0.24 VRMS

- 6.2.20.3.29 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the Indicator Control Panel to ZERO for 30 seconds, then return to OFF.
- 6.2.20.3.30 Insert in KI48
- a. VERB 33, ENTER
- 6.2.20.3.31 Observe on CRT
- a. V 06 N 02 Flashing
b. R1 -00135
c. R2 +00135
d. R3 +00003
- 6.2.20.3.32 Record CRT indications
- a. CG 3722 TRUNNION CDU DAC OUTPUT -3.56±0.36 VRMS
b. CG 3721 SHAFT CDU DAC OUTPUT +3.56±0.36 VRMS
- 6.2.20.3.33 Insert in KI48
- a. VERB 33, ENTER
- 6.2.20.3.34 Observe on CRT
- a. V 06 N 02 Flashing
b. R1 -00160
c. R2 +00160
d. R3 +00003
- 6.2.20.3.35 Record CRT indications
- a. CG 3722 TRUNNION CDU DAC OUTPUT -4.22±0.42 VRMS
b. CG 3721 SHAFT CDU DAC OUTPUT +4.22±0.42 VRMS
- 6.2.20.3.36 Insert in KI48
- a. VERB 33, ENTER
- 6.2.20.3.37 Observe on CRT
- a. V 06 N 02 Flashing
b. R1 -00384
c. R2 +00384
d. R3 +00003

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6.2.20.3.38 Record CRT indications

- | | | |
|------------|-------------------------|------------------|
| a. CG 3722 | TRUNNION CDU DAC OUTPUT | -10.12±1.00 VRMS |
| b. CG 3721 | SHAFT CDU DAC OUTPUT | +10.12±1.00 VRMS |

6.2.20.3.39 Insert in K148

- a. VERB 33, ENTER

6.2.20.3.40 Observe on CRT

- | | | |
|---------|------|----------|
| a. V 00 | N 02 | Flashing |
| b. R1 | | -00385 |
| c. R2 | | +00385 |
| d. R3 | | +00003 |

6.2.20.3.41 Record CRT indications

- | | | |
|------------|-------------------------|------------------|
| a. CG 3722 | TRUNNION CDU DAC OUTPUT | -10.12±1.00 VRMS |
| b. CG 3721 | SHAFT CDU DAC OUTPUT | +10.12±1.00 VRMS |

6.2.20.3.42 Insert in K148

- | | | |
|-----------|------|-------|
| a. V 34 | | ENTER |
| b. V 40 | N 20 | ENTER |
| c. V 41 | N 20 | ENTER |
| d. +00000 | | ENTER |
| e. +00000 | | ENTER |
| f. +00000 | | ENTER |

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APPENDIX I

Signal	Link	Nomenclature	G&N Test Requirement	PSAAM and/or SCA Uncertainty % of Full Scale
CG 1020	1	+14 VDC CMC SUPPLY	+14.0 ± 0.4 VDC	0%
CG 1030	1	+4 VDC CMC SUPPLY	+4.00 ± 0.2 VDC	0%
CG 1040	2	+120 VDC PIPA SUPPLY	+120 ± 6.0 VDC	1%
CG 1051	1	+20 VDC PIPA SUPPLY	+20.0 ± 1.2 VDC	0%
CG 1052	1	-20 VDC PIPA SUPPLY	-20 ± 2 VDC	0%
CG 1070	1	+4 VDC CDU SUPPLY	+4.0 ± 0.2 VDC	0%
CG 1100	1	-28 VDC SUPPLY	-27.5 ± 6.0 VDC	0%
CG 1110	2	2.5 VDC TM BIAS	+2.50 ± 0.06 VDC	0%
CG 1201	2	IMU 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	1%
CG 1202	1	IMU 28V .8 KC 5% - 90° RMS	28.0 ± 1.4 VRMS	0.33%
CG 1203	1	IMU 28V .8KC 0° RMS	28.0 ± 2.1 VRMS	0.33%
CG 1207	1	PH DIFF IMU 5% 0°, -90°	-90 ± 10°	2.3%
CG 1211	1	OPTX 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	0.33%
CG 1212	1	OPTX 28V .8KC 5% -90° RMS	28.00 ± 1.48 VRMS	0.33%
CG 1220	1	PH DIFF OPTX 1% IMU 1%	0° ± 10°	2.3%
CG 1331	2	3.2 KC 28V SUPPLY	28.6 ± 0.56 VRMS	1%
CG 1336	1	PH DIFF 3.2 KC 28V/CMC SYNC	0° ± 10°	2.3%
CG 1500	1	+28 VDC IMU OPERATE BUS	28.8 ± 3VDC	0%
CG 1510	1	+28 VDC IMU STANDBY BUS	28.8 ± 3 VDC	0%
CG 1520	1	+28 VDC CMC OPERATE BUS	28.8 ± 3 VDC	0%
CG 1530	1	+28 VDC OPTX OPERATE BUS	28.8 ± 3 VDC	0%
CG 2001	2	X PIPA SG O/P	5 VRMS max	3%
CG 2021	2	Y PIPA SG O/P	5 VRMS max	0.23%
CG 2041	2	Z PIPA SG O/P	5 VRMS max	3%
CG 2108	2	IG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3.6%
CG 2112	2	IG LX RESOLVER O/P SIN	18.38 ± 1.84 VRMS @ 45°	2.5%
CG 2113	2	IG LX RESOLVER O/P COS	18.38 ± 1.84 VRMS @ 45°	2.5%
CG 2117	2	IG SERVO ERROR IN PHASE	0.0 ± 60mv RMS @ null	1.4%
CG 2120	1	IG TORQUE MOTOR CURRENT	0.125 amp max during Fine Alignment Torquing	0%
CG 2138	1	MG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3.6%
CG 2142	2	MG LX RESOLVER O/P SIN	18.38 ± 1.84 VRMS @ 45°	2.5%
CG 2143	2	MG LX RESOLVER O/P COS	18.38 ± 1.84 VRMS @ 45°	2.5%
CG 2147	2	MG SERVO ERROR IN PHASE	0.0 ± 60 μv rms @ null	1.4%
CG 2150	1	MG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	0%
CG 2168	1	OG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3.6%
CG 2172	2	OG LX RESOLVER O/P SIN	18.38 ± 1.84 VRMS @ 45°	2.5%
CG 2173	2	OG LX RESOLVER O/P COS	18.38 ± 1.84 VRMS @ 45°	2.5%
CG 2177	2	OG SERVO ERROR IN PHASE	0.0 ± 60mv VRMS @ null	1.4%
CG 2180	1	OG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	0%
CG1042	1	+120 VDC PIPA SUP NOISE RMS	1.5 VRMS MAX	0%
CG1053	1	+20 VDC PIPA SUP NOISE RMS	1.0 VRMS MAX	0%
CG1071	1	+4 VDC CDU SUP NOISE RMS	0.10 VRMS MAX	0%
CG1501	1	+28V IMU OPERATE BUS NOISE RMS	1.0 VRMS MAX	0%
CG1511	1	+28V IMU STANDBY BUS NOISE RMS	1.0 VRMS MAX	0%
CG1531	1	+28V CMC OPERATE BUS NOISE RMS	2.0 VRMS MAX	0%
CG1531	1	+28V OPTX OPERATE BUS NOISE RMS	2.0 VRMS MAX	0%

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<u>Signal</u>	<u>Link</u>	<u>Nomenclature</u>	<u>G&N Test Requirement</u>	<u>PSAM and/or SCA Uncertainty % of Full Scale</u>
CG 2219	1	PITCH ATT ERROR - CDU DAC O/P	5.06 ± 0.5 VRMS @ 17°	0.67%
CG 2220	1	IG CDU FINE ERROR	0.0 ± 0.07VRMS @ null	0.29%
CG 2221	1	IG CDU COARSE ERROR	0.0 ± 0.68 VRMS @ null	0.29%
CG 2249	1	YAW ATT ERROR-CDU DAC O/P	5.06 ± 0.5 VRMS @ 17°	0.67%
CG 2250	1	MG CDU FINE ERROR	0.0 ± 0.07VRMS @ null	0.29%
CG 2251	1	MG CDU COARSE ERROR	0.0 ± 0.68VRMS @ null	0.29%
CG 2279	1	ROLL ATT ERROR-CDU DAC O/P	5.06 ± 0.5 VRMS @ 17°	0.67%
CG 2280	1	OG CDU FINE ERROR	0.0 ± 0.07 VRMS 2 null	0.29%
CG 2281	1	OG CDU COARSE ERROR	0.0 ± 0.68 VRMS	0.29%
CG 2300	1	PIPA TEMPERATURE	130. ± 0.5°F Operate Mode	2%
CG 3011	2	TRUNNION CDU FINE ERROR	0.0 ± 0.07VRMS @ null	0.29%
CG 3021	2	SHAFT CDU FINE ERROR	0.0 ± 0.07VRMS @ null	0.29%
CG 3117	1	SXT SHAFT SERVO ERROR IN PH	2 VRMS max	1.1%
CG 3118	1	SXT TRUNNION SERVO ERROR IN PHASE	2 VRMS max	1.1%
CG 3140	1	SXT SHAFT TACH O/P	3.3 ± 1.3 VRMS @ Hi Rate	1.1%
CG 3145	1	SXT SHAFT MTR CONTROL WINDING	+0.50 to +4.00 VRMS Mod Rate 1.1%	1.1%
CG 3150	1	SXT TRUNNION TACH O/P	3.3 ± 1.3 VRMS @ Hi Rate	1.1%
CG 3155	1	SXT TRUNNION MTR CONTROL WINDING	+0.55 to +2.09 VRMS Mod Rate 1.1%	1.1%
CG 3160	1	SCT SHAFT TACH O/P	3.3 ± 1.3 VRMS @ Hi Rate	1.1%
CG 3170	1	SCT TRUNNION TACH O/P	0.85 ± 0.35 VRMS @ Hi Rate	1.1%
CG 3721	1	SHAFT CDU DAC O/P	10.12 ± 1.09 VRMS @ 17°	1%
CG 3722	2	TRUNNION CDU DAC O/P	10.12 ± 1.09 VRMS @ 17°	1%
CG 4300	2	CMC TEMP	87.5 ± 0.5°F	0.23%
CG 6020	1	PIPA CAL MODULE TEMP	72.5 ± 0.5°F	0.23%
CG 6021	1	IMU 800 cps 5% TEMP (PSA)	90 ± 0.3°F	0%
CG 2301	1	IRIG TEMPERATURE	135 ± 2.5°F in Operate	2%
CG 1021	1	+14V CMC SUPPLY NOISERSMS	0.2 VRMS max	0%
CG 1021	1	+4 CMC SUPPLY NOISE RMS	0.2 VRMS max	0%

[illegible]

PSAAM OUTPUT is the source of Link 1 signals

SCA OUTPUT is the source of Link 2 signals.

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ADDENDUM I

SCOPE: The following changes are required to make ND1002325 applicable as G&N System technical support documentation for CSM 101.

Addition 1. Add paragraph 6.1.1.7 as follows:

6.1.1.7 Data from the on-board tape recorder shall be made available and the following signals verified:

- a. IG TORQUE MOTOR CURRENT (CG 2120) shall be less than 0.125 amp max.
- b. OG TORQUE MOTOR CURRENT (CG 2180) shall be less than 0.125 amp max.
- c. MG TORQUE MOTOR CURRENT (CG 2150) shall be less than 0.125 amp max.

Addition 2. Paragraph 6.2.1.5.6, change the last sentence to read as follows:

On the Event Recorder verify that the IMU HTR Current switch discrete (CG 2302 Link 2) is on and that the IMU Blower Current discrete (CG 2303 Link 2) is OFF over the last 2 hour period (occasionally discretizes may cycle).

Addition 3. Add paragraph 6.2.4.6.1 as follows:

6.2.4.6.1 On the analog recorder verify that (CG 1211 Link 2, OPTICS 28V 800 cps 1% 0 deg) RMS voltage is 28.0 ± 0.06 VAC.

Addition 4. Add Paragraph 6.2.20.2.5.1 and 6.2.20.2.32.1 as follows:

6.2.20.2.5.1 Verify on the analog recorder the following signals:

- a. CG 2279 Link 2 ROLL ATT ERROR - CDU DAC OUT $+5.06 \pm 0.66$ VRMS
- b. CM 2219 Link 2 PITCH ATT ERROR - CDU DAC OUT -5.06 ± 0.66 VRMS
- c. CG 2249 Link 2 YAW ATT ERROR - CDU DAC OUT $+5.06 \pm 0.66$ VRMS

6.2.20.2.32.1 Verify on the analog recorder the following signals:

- a. CG 2279 Link 2 ROLL ATT ERROR - CDU DAC OUT -5.06 ± 0.66 VRMS
- b. CG 2219 Link 2 PITCH ATT ERROR - CDU DAC OUT $+5.06 \pm 0.66$ VRMS
- c. CG 2249 Link 2 YAW ATT ERROR - CDU DAC OUT -5.06 ± 0.66 VRMS

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Addition 5. Paragraph 6.1.2.1., add new Paragraph 6.1.2.1.5 as follows:

6.1.2.1.5 Data from the on-board tape recorder shall be made available and the following signals verified.

- a. VIB NB ROLL (CG 6001)
- b. VIB NB PITCH (CG 6002)
- c. VIB NB YAW (CG 6003)

Addition 6. Replace Paragraph 6.2.3.1.13 with the following:

6.2.3.1.13 30 minutes after switching from Standby mode to the Operate mode record the IRIG temperature. The recorded IRIG temperature shall be within 0.5 deg F. of the Operate stabilized IRIG temperature determined below.

Add the following sentence to Paragraph 6.2.3.1.14:

Record the Operate mode stabilized IRIG temperature. The Operate mode stabilized IRIG temperature shall be 135±2.5° F.

Paragraph 6.2.5.2.16, add the following to Table VI:

14 CG 2301 IRIG TEMPERATURE

Addition 7. Paragraph 6.1.1.6, add item "f" as follows:

f. The TRACKER switch on G&N Indicator Control Panel shall be set to OFF.

Addition 8. Replace Paragraph 6.2.3.1.2 with the following:

6.2.3.1.2 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Switch and select on the G&N Indicator Control Panel shall be set as follows.

- a. CONTROLLER COUPLING to DIRECT
- a. OPTICS MODE to ZERO
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to MED
- d. TELESCOPE TRUNNION to SLAVE to SXT
- e. RETICLE BRIGHTNESS to minimum brightness position

Addition 9. Replace Paragraph 6.2.5.1.2 with the following:

6.2.5.1.2 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the

following switches on the G&N Indicator Control Panel to the positions designated.

- a. OPTICS MODE to ZERO
- b. CONTROLLER MODE to DIRECT
- c. CONTROLLER SPEED to LO
- d. TELESCOPE TRUNNION to SLAVE to SXT
- e. RETICLE BRIGHTNESS to minimum brightness position

Addition 10. Replace Paragraph 6.2.5.2.1 with the following:

6.2.5.2.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set or verify the following G&N Indicator Control Panel switches to the position indicated.

- a. CONDITION LAMPS to ON
- b. OPTICS MODE to ZERO
- c. CONTROLLER COUPLING to DIRECT
- d. CONTROLLER SPEED to LO
- e. TELESCOPE TRUNNION to SLAVE to SXT
- f. RETICLE BRIGHTNESS to minimum brightness position

Addition 11. Replace Paragraph 6.2.5.3.6 with the following:

6.2.5.3.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Insure that the following switches are set to the positions indicated:

- a. CONTROLLER COUPLING to DIRECT
- b. OPTICS MODE to ZERO
- c. TELESCOPE TRUNNION to SLAVE to SXT
- d. TRACKER to OFF
- e. CONTROLLER SPEED to LO
- f. CONDITION LAMPS to ON
- g. UP TELEMETRY to ACCEPT

Addition 12. Replace Paragraph 6.2.9.23 with the following:

6.2.9.23 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to CMC.

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Addition 13. Replace Sections 6.2.10 through 6.2.13 with the following:

6.2.10 Zero Optics Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2 Turn On Procedure before proceeding.

INITIALIZATION

6.2.10.1 Set the G/N POWER - OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.10.2 Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.

- VERB 41, NOUN 20, ENTER
- +00000, ENTER
- +00000, ENTER
- +00000, ENTER

6.2.10.3 Insure that the following switches on the G&N Indicator Control Panel are set as follows:

- TELESCOPE TRUNNION to SLAVE to SXT
- CONTROLLER COUPLING to DIRECT
- CONTROLLER SPEED to HI

OPTICS ZERO MODE TEST

6.2.10.4 Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K-148. Press the ENTER pushbutton.

6.2.10.5 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15-seconds; Verify the Optics have zeroed properly by observing the following on R1 and R2 of the DSKY (LOS angle)

- R1 = +0.00° +0.02° , -0.03° (Shaft Angle)
- R2 = +0.000° +0.006° , -0.007° (Trunnion LOS Angle)

6.2.10.5.1 Enter the following

VERB 01 NOUN 10, ENTER
00033, ENTER
Verify R1 = XXX&X

6.2.10.5.2 Set the OPTICS MODE switch to CMC. Enter the following:

ENTER
00033, ENTER
Verify R1 = XXX5X

6.2.10.5.3 Set the OPTICS MODE switch to MAN. Press the KEY REL pushbutton on the DSKY.

OPTICS BACKUP MODE TEST

6.2.10.6 Insert the Inflight Tool (V36601405) into the Trunnion Tool input and engage drive mechanism (button out). Verify that the trunnion turns by viewing the movement through the SCT eyepiece while turning the tool until the TPAC reads +5 deg. Remove the tool from the trunnion tool input.

6.2.10.7 Insert the Inflight Tool (V36601405) into the Shaft Tool input and engage the drive mechanism (button out). Verify that the Shaft turns by viewing the movement through the SCT eyepiece while turning the tool so that the shaft moves through an angle from 0° to +3 to -3 to 0 as indicated on the shaft TPAC. Disengage the shaft drive mechanism (button in) and remove the tool.

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6.2.10.8 *8* Insert the Inflight Tool (V36601405) into the Trunnion Tool input. Verify that the Trunnion Turns by viewing the movement through the SCT eye-piece while turning the tool so that the trunnion moves from +5° to -5° and back to zero as indicated on the Trunnion TPAC. Disengage the trunnion drive mechanism (button in) and remove the tool.

6.2.11 Optics Coordinate Transformation Control Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure before proceeding.

INITIALIZATION

6.2.11.1 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.11.2 Enter the following into the K-Start. Press the ENTER pushbutton after each entry:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.11.3 Verify and/or set the following switches on the G&N Indicator control panel to the position indicated.

- a. TELESCOPE TRUNNION to SLAVE to SXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to HI

6.2.11.4 Set up the analog recorders to monitor the following measurements.

- a. CG 3170 SCT Trunnion Tachometer Output

6.2.11.5 Enter the following into the K-Start to monitor the OPTICS CDU's.

VERB 16 NOUN 55, press ENTER

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- 6.2.11.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the G&N Panel to ZERO. Wait 15 seconds. Return the OPTICS MODE switch to MAN.
- RESOLVED MODE PHASING AND IMAGE RATE TEST
- 6.2.11.7 Using the Optics Control Stick, drive the Optics until $R1 = +225.00$ and $R2 = +10.000$ on the CRT and the DSKY's.
- 6.2.11.8 Set the CONTROLLER COUPLING switch on the G&N Panel to RSLV and CONTROLLER SPEED switch to MED.
- 6.2.11.9 Position the movable optics target such that it is centered on the SCT reticle pattern, then start the analog recorders at a chart speed of 10 mm/second.
- 6.2.11.10 Quickly displace the Optics Control Stick 45 ± 10 degrees in the upper right hand quadrant while sighting on the optics target through the SCT eyepiece. The target shall appear to move in the upper right field of view of the SCT at 45 ± 10 deg. When target leaves the SCT upper right field of view press MARK pushbutton and immediately record the shaft angle as displayed on R1 of the DSKY. The recorded shaft angle shall be $+225 \pm 10.00$ degrees.
- 6.2.11.11 Stop the analog recorder and measure the elapsed time between the initial and the final signal null conditions for the Trunnion measurement. The elapsed time shall be $+19$ to $+32$ seconds.
- CSM AMPLIFIER SHAFT AND TRUNNION DRIVE TEST
- 6.2.11.12 Set the CONTROLLER COUPLING switch to DIRECT. Again using the Optics Control Stick, drive the optics until $R1 = +225.00$ and $R2 = +10.000$. Set the CONTROLLER COUPLING switch to RSLV.
- 6.2.11.13 While sighting on the optical target through the SCT eyepiece, displace the Optics Control Stick fully to the right. Verify that the target image appears to move in a straight line horizontally to the right and release the Optics Control Stick when the target image reaches the edge of the SCT field of view.
- 6.2.11.14 Enter VERB 34 in the DSKY. Press the ENTER pushbutton.

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6.2.11.15

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the CONTROL-
LER COUPLING switch on the G&N Panel to DIRECT. Set the OPTICS MODE switch to ZERO. After 15 seconds, return the switch to MAN.

NOTE: If optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.12

Optics Functional Test

Proceed with this test if 6.2.3 Operate Power On Test, or 6.2.5.2 Turn-on Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding.

NOTE: This test requires the use of the G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT StLOS before proceeding. Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.

6.2.12.1

Set/verify the G/N POWER OPTICS switch on the LEB Lighting Control Panel to OPTICS. Set TRACKER switch to OFF. Verify the following:

- +28 VDC OPTX OPERATE BUS (CG 1530) is 28.8±3 VDC. Record the indication on the CRT.
- CG 1211 OPTX 28V 800 cps 1% 0 ph not flashing on CRT.
- CG 1212 OPTX 800 cps 5% -90 ph not flashing on CRT.

6.2.12.2

Enter the following sequence into the K-Start.

- VERB 41, NOUN 20, ENTER
- +00000, ENTER
- +00000, ENTER
- +00000, ENTER

6.2.12.3

Insure that the optics control switches on the G&N Indicator Control Panel are set as follows:

- OPTICS MODE to MAN
- CONTROLLER SPEED to LO
- CONTROLLER COUPLING to DIRECT
- TELESCOPE TRUNNION to SLAVE to SXT

- 6.2.12.4 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees to zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN.
- 6.2.12.5 Resolution Checks
- 6.2.12.5.1 Sight through the SXT eyepiece. Using the Optic Control Stick, adjust the SXT to obtain the best reflected field of view of the 5-inch autocollimator reticle engraving at the center of the field of view.
- 6.2.12.5.2 Note that the autocollimator reticle contains a series of lines of different thickness and width. Each set of lines is marked with a number (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines. The SXT resolution shall be at least 10 arc-seconds at the center of the field of view.
- 6.2.12.5.3 Repeat 6.2.12.5.1 and 6.2.12.5.2 using the SCT and the SCT resolution chart. The SCT shall have a resolution of at least 3 arc-minutes at the center of the field of view.
- 6.2.12.6 Slave Telescope Mode Checks
- 6.2.12.6.1 Enter VERB 16 NOUN 55 into the K-Start, press the ENTER pushbutton.
- 6.2.12.6.2 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the Control Indicator Panel to ZERO. Wait 15 seconds.
- 6.2.12.6.3 Record the SCT Shaft and Trunnion angles as indicated by the TPAC and the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between the TPAC shaft angle and the Shaft CDU angle shall be ± 0.11 deg or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be ± 0.22 deg or less.

- 6.2.12.6.4 Place the OPTICS MODE switch to MAN. Using the Optics Control Stick drive the SXT Shaft and Trunnion CDU's until $R1 = 035.00 \pm 0.10$ deg and $R2 = +35.000 \pm 0.100$ deg, setting the CONTROLLER SPEED switch to LO as the angles are approached. Press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles as indicated by the TPAC. Record $R1$ and $R2$. The difference between the TPAC Shaft angle and Shaft CDU angle shall be ± 0.11 deg or less. The difference between the TPAC Trunnion angle and Trunnion CDU angle shall be ± 0.22 deg or less.
- 6.2.12.6.5 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO.
- 6.2.12.6.6 Set the TELESCOPE TRUNNION switch to SLAVE to SXT position.
- 6.2.12.6.7 Remove the plug from the base of the SXT eyepiece and install the Adapter Assembly and Portable Light Assembly. Turn on the light.
- NOTE: If needed to reduce external light, place a photograph hood over the optics head and retroreflecting prism.
- 6.2.12.6.8 Sight through the SCT eyepiece and provide direction to personnel outside spacecraft for positioning the Retroreflecting Prism, Model No. A23-200, to span between the SXT LOS and SCT LOS such that the illumination from the back-light filament is clearly visible at the center of the field of view. Prism must be held in this alignment position until completion of step 6.2.12.6.11.
- 6.2.12.6.9 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Note the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement, expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. For instance, the outer ends of the SXT reticle lines are 6% from center. Displacement shall be less than 50% (bar must be closer to center than to edge of field of view).
- 6.2.12.6.10 Set the TELESCOPE TRUNNION switch to 0° position.
- 6.2.12.6.11 Again direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in Step 6.2.12.6.9. Place the OPTICS MODE switch to MAN and observe the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement, expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. Displacement shall be less than 50%.
- 6.2.12.6.12 Remove the Retroreflecting Prism.

- 6.2.12.6.13 Replace the Portable Light in the adapter on the SXT eyepiece.
- 6.2.12.6.14 While sighting into the SCT eyepiece, set the TELESCOPE TRUNNION switch to 25° and observe that the resolution pattern mounted outside the spacecraft appears to move downward from the center of the field of view to the zero reticle marking that is 25° below the center of the field of view.
- 6.2.12.6.15 Record the TPAC Trunnion Angle. It shall be 25.00 ± 0.22 deg.
- 6.2.12.6.16 Set the TELESCOPE TRUNNION switch to SLAVE to SXT.
- 6.2.12.7 SXT Parallelism Tests
- 6.2.12.7.1 Using the Optics Control Stick drive the SXT StLOS Trunnion to $+15.000^\circ \pm 2^\circ$ as indicated in R2 of the DSKY. Maintain a Shaft CDU angle of 000.00 ± 0.10 degrees as indicated by R1 of the DSKY.
- 6.2.12.7.2 Sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to superimpose the SXT LLOS horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.
- 6.2.12.7.3 Repeat 6.2.12.7.2 twice. Calculate and record the average of the three autocollimator readings.
- 6.2.12.7.4 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO.
- 6.2.12.7.5 Again sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to bring the SXT StLOS horizontal reticle and autocollimator horizontal filar images to coincide. Record the autocollimator reading.
- 6.2.12.7.6 Repeat 6.2.12.7.5 twice. Calculate and record the average of the three autocollimator readings. The average value obtained here shall not differ from that obtained in 6.2.12.7.3 by more than 10 arc-seconds.
- 6.2.12.7.7 Set the OPTICS MODE switch to MAN. Using the Optics Control Stick drive the SXT Trunnion angle to 85.00 ± 5 degrees as indicated on R2 of the DSKY. Set the CONTROLLER SPEED switch to LO and drive the SXT Trunnion to $+90.000$ degrees ± 0.100 degree as indicated on R2 of the DSKY. Insure that the SXT Shaft angle remains at 000.00 ± 0.10 degree as indicated by R1 on the DSKY.
- 6.2.12.7.8 Sight through the SXT. Two reticle patterns shall be visible. Use the Optics Control Stick to adjust the SXT Trunnion angle until the two horizontal reticle lines are coincident. Record the Trunnion CDU angle displayed in R2. The Trunnion CDU angle shall be 90.000 ± 0.10 degrees.
- 6.2.12.7.9 Remove the Portable Light Assembly and Adapter Assembly from the base of the SXT eyepiece. Replace the SXT eyepiece plug.

NOTE: If optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

- 6.2.12.8 Shaft and Trunnion Positional Accuracy Checks
- 6.2.12.8.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds, return the selector to Manual.
- 6.2.12.8.2 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.3 Sight through the SXT. Using the control stick align the SXT SLOS with optical Target No. 1 on the G&N Installation Fixture Model A23-097. Set the CONTROLLER SPEED switch to LO as the target is approached. When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.
- 6.2.12.8.4 Sight through the SXT. Using the control stick align the SXT SLOS with Optical Target No. 2 on A23-097. Set the CONTROLLER SPEED switch to LO as the target is approached.
- 6.2.12.8.5 When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.
- 6.2.12.8.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds set the switch to CMC.
- 6.2.12.8.7 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.8 Enter the value recorded from R1 in 6.2.12.8.3 into the K-Start. Press the enter pushbutton.
- 6.2.12.8.9 Enter the value recorded from R2 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.10 Sight through the SXT. The SLOS should be centered on Optical Target No. 1 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.3 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.11 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.12 Enter the value recorded from R1 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.

- 6.2.12.8.13 Enter the value recorded from R2 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.14 Sight through the SXT. The SLOS should be centered on Optical Target No. 2 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.5 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.15 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MANUAL.
- 6.2.12.8.16 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start 3 times. Press the ENTER pushbutton after each entry.
- 6.2.13 Optics Slew Rate Test
- NOTE: Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.13.1 Set/verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CB 1630) is +28.0±3.0 VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT. Set TRACKER switch to OFF.
- 6.2.13.2 Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.
- VERB 41 NOUN 20, ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER
- 6.2.13.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the positions indicated.
- TELESCOPE TRUNNION to SLAVE to SXT
 - CONTROLLER COUPLING to DIRECT
 - CONTROLLER SPEED to HI
- 6.2.13.4 Monitor MARK Command by entering VERB 06 NOUN 56 into K-148. Press the ENTER pushbutton.

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TRUNNION SLEW RATE - HI SPEED

6.2.13.5.1 During the Trunnion Slew Rate Test HI Speed, monitor and verify the following signals on the CRT.

- a. SXT TRUNNION TACH O/P (CG 3150 LINK 2) shall be 3.3 ± 1.3 VRMS
b. SCT TRUNNION TACH O/P (CG 3170 LINK 2) shall be -0.85 ± 0.35 VRMS
NOTE: Read and understand step 6.2.13.6 before proceeding. Do not hold Control Stick at upper limit more than 10 seconds, or exceed a trunnion angle of 85 degrees. Control Stick at upper limit more than 10 seconds, or exceed a

6.2.13.6 While slewing the optics, record the SKT TRUN SERVO error (CG 3118); it shall be between -0.25 and 2.0 VRMS.

6.2.13.6 Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R2 = ±XX.XXX (Trunnion LOS angle in deg)
b. R3 = +XXX.XX (Time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.7 **Perform the following calculations:**

NOTE: In performing calculation b. below, and in similar calculations throughout this test procedure, the following shall be noted and taken into account. It is possible that the second R3 reading may be smaller than the first reading. If so, add an overflow time value of 163.84 sec to the second reading and then subtract the first reading, in order to obtain Δ time as the difference of the two R3 readings.

- a. Difference between R2 displays = _____ (Δ trunnion angle)
 b. Difference between R3 displays = _____ (Δ time)
 c. $\frac{\Delta \text{trunnion angle}}{\Delta \text{time}} = \text{---} \text{ deg/sec}$

The Trunnion Slew Rate shall be 10 ± 2 deg/sec.

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SHAFT SLEW RATE - HI SPEED

6.2.13.8 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

6.2.13.8.1 During the Shaft Slew Rate Test - HI Speed, monitor and verify the following signals on the CRT.

- a. SXT SHAFT TACH O/P (CG 3140 Link 2) shall be 3.5 ± 1.3 VRMS
 - b. SCT SHAFT TACH O/P (CG 3160 Link 2) shall be 3.3 ± 1.3 VRMS
- NOTE: Read and understand step 6.2.13.9 before proceeding. Do not hold Control Stick at right limit for more than 10 seconds, or exceed a shaft angle of 230 degrees, at right limit for more than 10 seconds, or

6.2.13.9 While slewing the optics, record the SXT SHAFT SERVO error (CG 3117); it shall be between -0.25 and -2.0 VRMS.

6.2.13.9 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R1 = +XXX.XX (shaft angles in deg)
- b. R3 = +XXX.XX (time in seconds)

After the display has changed, again record the values of R1 and R3.

6.2.13.10 Perform the following calculations:

- a. Difference between R1 displays = ____ . ____ (Δ shaft angle)
- b. Difference between R3 displays = ____ . ____ (Δ time)
- c. $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{____ . ____ deg/sec}$

The Shaft Slew Rate shall be 19.5 ± 3.9 deg/sec.

TRUNNION SLEW RATE - MED SPEED

- 6.2.13.11 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to MED. Monitor MARK command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.12 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

- 6.2.13.12 Record the SXT TRUN MTR control winding (CG 3155) and SXT TRUN TACH (CG 3150) signals on the CRT while slewing the optics. CG 3155 shall be $+0.25$ to $+2.00$ VRMS, and CG 3150 shall be $+0.33 \pm 0.13$ VRMS. Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R2 = $\pm XX.XXX$ (trunnion LOS angle in deg)
- b. R3 = $\pm XXX.XX$ (time in seconds)

After the display has changed, again record the values of R2 and R3.

- 6.2.13.13 Perform the following calculations:

- a. Difference between R2 displays = $\text{---} \cdot \text{---}$ (Δ trunnion angle)
- b. Difference between R3 displays = $\text{---} \cdot \text{---}$ (Δ time)
- c. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}} = \text{---} \cdot \text{---}$ deg/sec

The Trunnion Slew Rate shall be 1.0 ± 0.2 deg/sec.

SHAFT SLEW RATE - MED SPEED

- 6.2.13.14 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS Mode switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.15 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.15

Record the SXT SHAFT MTR control winding (CG 3145), SXT SHAFT TACH, and SXT SHAFT TACH (CG 3140) signals on the CRT while slewing the optics. CG 3145 shall be ± 0.50 to ± 4.00 VRMS, and CG 3140 shall be 0.33 ± 0.15 VRMS. Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R1 = $\pm XXX.XX$ (shaft angle in deg)
- b. R3 = $\pm XXX.XX$ (time in seconds)

After display has changed, again record the values of R1 and R3.

6.2.13.16

Perform the following calculations:

- a. Difference between R1 displays = $--- \cdot ---$ (Δ shaft angle)
- b. Difference between R3 displays = $--- \cdot ---$ (Δ time)
- c. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = _ \cdot _ \text{ deg/sec}$

The Shaft Slew Rate shall be 2.0 ± 0.4 deg/sec.

TRUNNION SLEW RATE - LO SPEED

6.2.13.17

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the Controller SPEED switch to LO. Monitor MARK Command by entering VERB 06 NOUN 56 in K-146. Press the ENTER pushbutton.

6.2.13.17.1

During the Trunnion Slew Rate Test-Lo Speed, monitor and verify the following signal on the CRT.

- a. TRUNNION CDU FINE ERROR (CG 3011 Link 2) ± 0.07 VRMS MAX

NOTE: Read and understand 6.2.13.16 before proceeding. Do not hold control stick at upper limit for more than 30 seconds.

6.2.13.18

Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R2 = $\pm XX.XXX$ (trunnion LOS angle in deg)
- b. R3 = $\pm XXX.XX$ (time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.19 Perform the following calculations:

- a. Difference between R2 displays = XX.XXX (Δ trunnion angle)
- b. Difference between R3 displays = XXX.XX (Δ time)
- c. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}} = \text{---} \cdot \text{---} \text{ deg/sec}$

The Trunnion Slew Rate shall be $0.10 \pm 0.02 \text{ deg/sec}$

SHAFT SLEW RATE - LO SPEED

6.2.13.20 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Monitor MARK Command by entering Verb 06 NOUN 56 in K-148. Press the ENTER pushbutton.

6.2.13.20.1 During the Shaft Slew Rate Test - Lo Speed, monitor and verify the following signal on the CRT.

- a. SHAFT CDU FINE ERROR (CG 3021 Line 2) $\pm .07 \text{ VRMS MAX}$

NOTE: Read and understand 6.2.13.21 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.21 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R1 = $\pm \text{XXX.XX}$ (shaft angles in deg)
- b. R3 = $\pm \text{XXX.XX}$ (time in seconds)

After the display has changed, again record the values of R1 and R3.

6.2.13.22 Perform the following calculations:

- a. Difference between R1 displays = $\text{---} \cdot \text{---}$ (Δ shaft angle)
- b. Difference between R3 displays = $\text{---} \cdot \text{---}$ (Δ time)
- c. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \text{---} \cdot \text{---} \text{ deg/sec}$

The Shaft Slew Rate shall be $0.20 \pm 0.04 \text{ deg/sec}$

OPTICS HAND CONTROLLER DRIFT RATE CHECK-LO SPEED

6.2.13.23 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

6.2.13.24 Press the MARK pushbutton and record the display in R1, R2, and R3. Approximately 60 seconds after the first MARK, again press the first MARK pushbutton and record the new data displayed in R1, R2 and R3. The data displayed is in the following form:

- a. R1 = +XXX.XX (shaft angle in deg)
- b. R2 = +XX.XXX (trunnion LOS angle in deg)
- c. R3 = +XXX.XX (time in seconds)

6.2.13.25 Perform the following calculations:

- a. Difference between R1 displays = _____ (Δ shaft angle)
- b. Difference between R2 displays = _____ (Δ trunnion angle)
- c. Difference between R3 displays = _____ (Δ time)
- d. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \text{_____ deg/sec (Shaft Drift Rate)}$

Shall be less than 0.0333 deg/sec.

- e. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}} = \text{_____ deg/sec (Trunnion Drift Rate)}$

Shall be less than 0.0167 deg/sec.

6.2.13.26 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

Addition 14. Replace Paragraph 6.2.17.5 and 6.2.17.20 with the following:

6.2.17.5 On the G&N Indicator Control Panel, set the following switches to the position indicated.

- a. TELESCOPE TRUNNION to SLAVE to SXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to LO
- d. OPTICS MODE to MAN

6.2.17.20 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN. Enter VERB 33, ENTER into the DSKY.

Addition 15. Replace Paragraphs 6.2.18.10.1, 6.2.18.10.2, 6.2.18.19, 6.2.18.20, and 6.2.18.22 with the following:

6.2.18.10.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Between 235 minutes and 240 minutes from T₀ set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.

6.2.18.10.2 Enter the following into the DSKY:

- a. VERB 21 NOUN 03 ENTER
- b. 02663 ENTER
- c. +XXX.XX±000.01 ENTER (Target No. 1 Az)
- d. Press ENTER pushbutton
- e. 02664 ENTER
- f. +XXX.XX±000.01 ENTER (Target No. 2 Az)
- g. Press ENTER pushbutton
- h. 02665 ENTER
- i. +00.000 ENTER (Target No. 1 EL)
- j. Press ENTER pushbutton
- k. 02666 ENTER
- l. +00.000 ENTER (Target No. 2 EL)

On the G&N Indicator Control Panel, set the OPTICS MODE switch to MAN and the CONTROLLER SPEED switch to HI. Drive the St. LOS to the approximate position of Target No. 1. Set the CONTROLLER SPEED switch to LO.

NOTE: Read the following 10 steps before proceeding. These are time critical steps and must be performed as rapidly as possible.

6.2.18.19 Set the CONTROLLER SPEED switch to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target 2.

6.2.18.20 Set the CONTROLLER SPEED switch to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 2 and press the MARK pushbutton. If satisfied that the MARK was good, press the ENTER pushbutton. If not satisfied, press the MARK REJECT pushbutton and repeat this step.

- 6.2.18.22** Enter VERB 34 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT and DSKY's indicate 02. Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the G&N Indicator Control Panel to Zero.
- Addition 16.** Replace Paragraph 6.2.20.3.2, 6.2.20.3.22, and 6.2.20.3.29 with the following:
- 6.2.20.3.2** Set the OPTICS MODE selector on the Indicator Control Panel to MAN.
- 6.2.20.3.22** Set the OPTICS CONTROLLER SPEED switch on the Indicator Control Panel to HI.
- 6.2.20.3.29** Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the Indicator Control Panel to ZERO for 30 seconds, then return to MAN.

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ADDENDUM II

SCOPE: The following changes are required to make ND1002325 applicable as G&N System technical support documentation for systems containing SUNDIAL C test ropes. Refer to Drawing 2014999 to define further which test ropes and jumper modules shall be installed.

- Change 1:** Paragraphs 6.2.9.1.4, 6.2.9.2a, 6.2.9.3a, 6.2.9.5a, 6.2.9.6a, 6.2.9.7a, 6.2.9.8, 6.2.9.10a, 6.2.9.11a, 6.2.9.13a, 6.2.9.15a, 6.2.9.16a, 6.2.9.23. In each of these paragraphs change "VERB 06 NOUN XX flashing" to "VERB 33 NOUN XX flashing."
- Change 2:** Paragraphs 6.2.20.2.2a, 6.2.20.2.4a, 6.2.20.2.7a, 6.2.20.2.10a, 6.2.20.2.13a, 6.2.20.2.16a, 6.2.20.2.19a, 6.2.20.2.22a, 6.2.20.2.25a, 6.2.20.2.28a, 6.2.20.2.31a, 6.2.20.2.34a, 6.2.20.2.37a, 6.2.20.3.8a, 6.2.20.3.11a, 6.2.20.3.14a, 6.2.20.3.17a, 6.2.20.3.20a, 6.2.20.3.24a, 6.2.20.3.27a, 6.2.20.3.31a, 6.2.20.3.34a, 6.2.20.3.37a, 6.2.20.3.40a; in each of these steps, change "V06" to "V33".
- Change 3:** Paragraph 6.2.16.7.19 Change FROM: On K-148 enter the following sequence:
- | | | |
|---------|---------|------|
| VERB 21 | NOUN 01 | ENTR |
| 00407 | | ENTR |
| 77757 | | ENTR |
| VERB 21 | NOUN 01 | ENTR |
| 00411 | | ENTR |
| 00020 | | ENTR |
| VERB 33 | | ENTR |
- Change TO: On K-148 enter the following sequence:
- | | | |
|---------|---------|------|
| VERB 21 | NOUN 01 | ENTR |
| 02502 | | ENTR |
| 77757 | | ENTR |
| VERB 21 | NOUN 01 | ENTR |
| 02504 | | ENTR |
| 00020 | | ENTR |
| VERB 33 | | ENTR |
- Change 4:** Paragraph 6.2.16.7.33 Change FROM: On K-148 enter the following sequence:
- | | | |
|---------|---------|------|
| VERB 21 | NOUN 01 | ENTR |
| 00405 | | ENTR |
| 00020 | | ENTR |
| VERB 21 | NOUN 01 | ENTR |
| 00407 | | ENTR |
| 77757 | | ENTR |
| VERB 33 | | ENTR |

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ADDENDUM II

Change 4
(Continued)

Change TO: On K-148 enter the following sequence:

VERB 21	NOUN 01	ENTR
02500		ENTR
00020		ENTR
VERB 21	NOUN 01	ENTR
02502		ENTR
77757		ENTR
VERB 33		ENTR

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ADDENDUM III

SCOPE. The following changes are required to make ND1002325 applicable on G&N System technical support documentation for CSM 2TV-1.

Change:1: Make the changes as specified in Additions 11 through 20 of Addendum I.
Delete the following paragraphs from Addition 17: 6.2.13.5.1, 6.2.13.6.1,
6.2.13.17.1, 6.2.13.20.1.

APOLLO G&N Specification
 ND1002325 REV M
 Original Issue Date:
 Release Authority: TDRR 31414
 Class A Release

POST INSTALLATION CHECKOUT PROCESS
SPECIFICATION FOR THE APOLLO GUIDANCE
AND NAVIGATION SYSTEM - BLOCK II

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
6/21/68	M	36708	8-13, 33-36, 45, 66, 67, 71, 72, 81, 103-162. Was 162 pages, now 163 pages. Specification now comprises a total of 165 pages.	SB	WLS

This specification consists of pages 1 to 163 including Appendix I, pages 138-139, Addendum I, pages 140-160, Addendum II, pages 161-162 and Addendum III, page 163.

APPROVALS	Not required per CCA-497-0274	MIT/IL	R. D. Petryk	D. A. Ziemer
	NASA/MSC			
			AC	

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5.4 Test Sequence

- 5.4.1 The test sequence normally should follow the flow outlined by Figure 1 in the order specified except 6.2.5. Turn On and Turn Off procedure, which may be performed as the requirement arises. The following is a complete listing of tests.

6.2.5 G&N TESTS

Paragraph No.

- | | |
|--------|---|
| 6.1.3 | Prepower Application Tests (Part of G&N Installation OCP) |
| 6.2.1 | Application of Standby Power to G&N System |
| 6.2.2 | CMC Operational Test |
| 6.2.3 | Operate Power On Test |
| 6.2.4 | G&N Power Supplies Test |
| 6.2.5 | General Turn Off and Turn On Procedure |
| 6.2.6 | G&N Operational Test |
| 6.2.7 | Gimbal Friction Test |
| 6.2.8 | G&N Panel Brightness & Lamp Test |
| 6.2.9 | Semi-Automatic Mode Control Test |
| 6.2.10 | Zero Optics Test |
| 6.2.11 | Optics Coordinate Transformation Control Test |
| 6.2.12 | Optics Functional Test, say Test |
| 6.2.13 | Optics Slew Rate Test |
| 6.2.14 | Stabilization Loop Step Response Test |
| 6.2.15 | IRIG Scale Factor Test |
| 6.2.16 | IMU Performance Test |
| 6.2.17 | Fine Alignment Test EXT-NB-IMU |
| 6.2.18 | Gyrocompassing Test |
| 6.2.19 | Voltage Margin Test |
| 6.2.20 | S/C Control & Display Test |

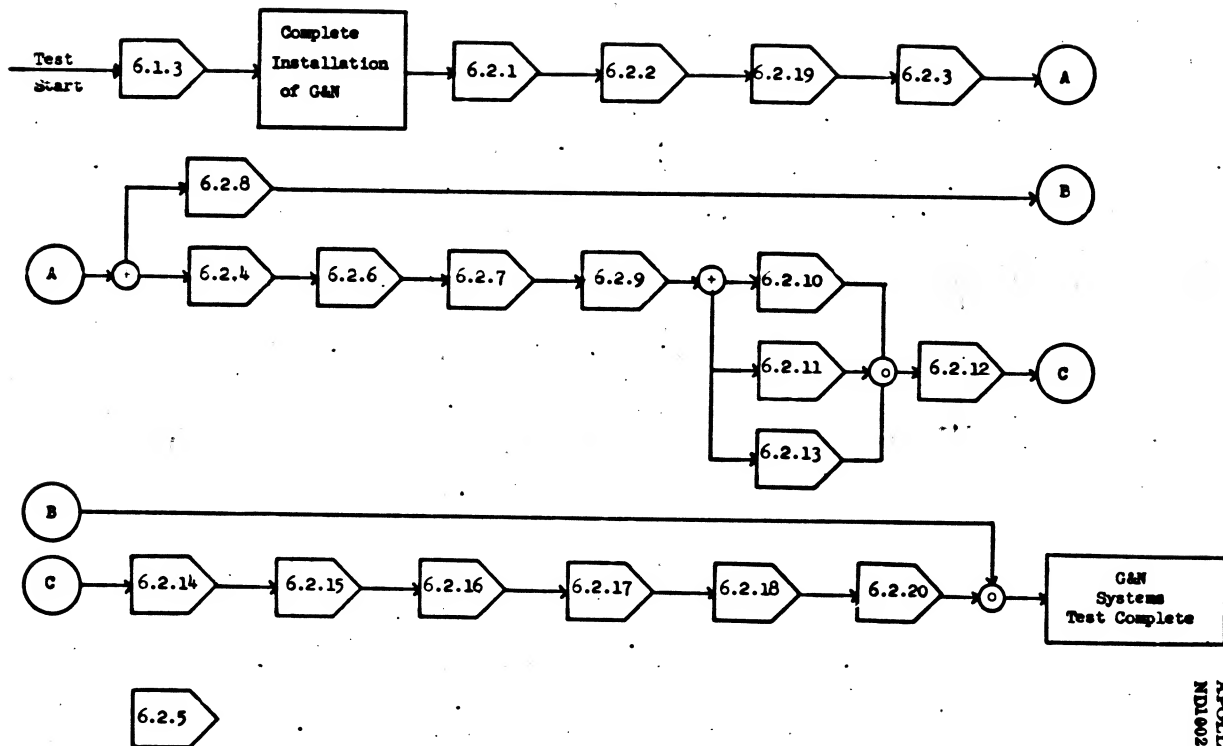


FIGURE 1 - TEST PROCEDURE FLOWGRAM

6.2.16.7.X where X is listed below

6.2.16.7

[illegible]

- ```

WR5 WFR
+00001 WFR
+00000 WFR
+0000X WFR Where X is the Test position number represented in BMY Row 3 display.

```

- 3 When VIMS 06 HOUR 66 flashes do not record test results.

### TABLE 1 RETEST SEQUENCE

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|        |                 |  |  |  |  |  |      |
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TABLE II

| O. O. S.<br>PARAMETER | PERFORM<br>POSITIONS  | PARAMETERS TO BE REQUALIFIED       |
|-----------------------|-----------------------|------------------------------------|
| NBDY                  | 1                     | NBDY                               |
| NBDZ                  | 2                     | NBDZ                               |
| NBDX                  | 3                     | NBDX                               |
| ADSRAY                | 1 and 4               | ADSRAY, NBDY                       |
| ADGRAZ                | 2 and 9               | ADGRAZ, NBDZ                       |
| ADSRAX                | 3 and 7               | ADSRAX, NBDX                       |
| ADIA Y                | 1 thru 3,<br>7 and 10 | NBDY, NBDX, ADIAX, ADSRAX, ADIA Y, |
| ADIAZ                 | 2 thru 4              | NBDZ, NBDX, ADIAZ                  |
| ADIAX                 | 1 thru 3              | NBDX, ADIAX, NBDY, NBDZ            |
| X PIPA Bias S. F.     | 1 thru 2              | X PIPA BIAS, X PIPA S. F.          |
| Y PIPA Bias S. F.     | 5 and 6               | Y PIPA BIAS<br>Y PIPA S. F.        |
| Z PIPA Bias or S. F.  | 3 and 4               | Z PIPA Bias<br>Z PIPA S. F.        |

TABLE III

## RETEST MATRIX

| Paragraph Number | Test Title                                 | IMU | NAV BASE | OPTICS | CMC | PSA | LEB DSKY | MDC DSKY | SIGN COND | CDU | G&N HARNESS | PIPA ELECT. | INDICATOR CONTROL PANEL |
|------------------|--------------------------------------------|-----|----------|--------|-----|-----|----------|----------|-----------|-----|-------------|-------------|-------------------------|
| 6.1.3            | Pre-Power Application Tests                | X   | X        | X      | X   | X   | X        | X        | X         | X   | X           | X           | X                       |
| 6.2.1            | Application of Standby Power to G&N System | X   | X        |        | X   | X   | X        | X        | X         | X   | X           | X           |                         |
| 6.2.5            | General Turn OFF and Turn ON Procedure     | *   | *        | *      | *   | *   | *        | *        | *         | *   | *           | *           | *                       |
| 6.2.3            | Operate Power On Test                      | X   | X        |        | X   | X   |          |          | X         | X   | X           | X           |                         |
| 6.2.2            | CMC Operational Test                       |     |          |        | X   |     | X        |          |           | X   | X           |             | X                       |
| 6.2.8            | G&N Panel Brightness and Lamp Test         | X   | X        | X      |     | X   |          | X        |           |     | X           |             | X                       |
| 6.2.6            | G&N Operational Test                       | X   | X        |        | X   | X   |          |          |           | X   | X           | X           |                         |
| 6.2.10           | Zero Optics Test                           |     | X        | X      |     | X   |          |          | X         | X   | X           |             | X                       |
| 6.2.13           | Optics Slew Rate Test                      |     | X        | X      |     |     |          |          | X         | X   | X           |             | X                       |
| 6.2.11           | Optics Coordinate Transformation Control   |     | X        | X      |     | X   |          |          |           | X   | X           |             | X                       |
| 6.2.12           | Optics Functional Test                     |     | X        | X      | X   | X   |          |          |           | X   | X           |             | X                       |
| 6.2.9            | Semi-Automatic Mode Control Test           | X   | X        | X      |     | X   |          |          | X         | X   | X           |             |                         |
| 6.2.14           | Stab Loop Step Response Test               | X   | X        |        |     | X   |          |          | X         |     |             |             |                         |
| 6.2.15           | IRIG Scale Factor Test                     | X   | X        |        |     | X   |          |          |           |     |             |             |                         |
| 6.2.16           | IMU Performance Test                       | X   | X        |        |     | X   |          |          |           |     |             | X           |                         |
| 6.2.17           | Fine Alignment Test                        | X   | X        | X      |     |     |          |          |           | X   | X           |             |                         |
| 6.2.19           | Voltage Margin Test                        |     |          |        | X   |     |          |          |           | X   | X           |             |                         |
| 6.2.7            | Gimbal Friction Test                       | X   | X        |        |     |     |          |          | X         |     | X           |             |                         |
| 6.2.18           | Gyrocompassing Test                        | X   | X        |        |     | X   |          |          |           |     |             | X           |                         |
| 6.2.4            | G&N Power Supplies Test                    |     | X        |        | X   | X   |          |          | X         | X   | X           | X           |                         |
| 6.2.20           | Spacecraft Control and Displays Test       |     |          |        | X   |     |          |          |           | X   | X           |             |                         |

\* To be used as necessary to turn system on and off.

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NORTH AMERICAN AVIATION, INC.  
 SPACECRAFT CONTROL SYSTEMS  
 15111 LANTANA BLVD  
 VAN NUYS, CALIFORNIA 91411

CODE IDENT. NO. 03933

APOLLO G&N Specification  
 ND1002325 REV N



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**6.2.2.6 Parity Fail Test**

**6.2.2.6.1** Enter the following into the K-Start. Press the ENTER pushbutton after each entry.

- a. VERB 24, NOUN 01, ENTER
- b. 01600, ENTER
- c. 33777, ENTER
- d. 04353 ENTER
- e. VERB 25 NOUN 26, ENTER
- f. 04000, ENTER
- g. 01600, ENTER
- h. 00003, ENTER
- i. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 06 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROW 1 shall indicate 00000.

**6.2.2.6.2** Press the ERROR RESET pushbutton on the K-Start. The RESTART & PGNS caution lamps shall extinguish.

**6.2.2.6.3** Enter VERB 36, into the K-START. Press the ENTER pushbutton.

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**6.2.2.3 Rupt Lock Test**

**6.2.2.3.1** Enter the following sequence into the K-Start. Press the ENTER pushbutton after each entry.

- a. VERB 24 NOUN 01, ENTER
- b. 01600, ENTER
- c. 30001, ENTER
- d. 01600, ENTER
- e. VERB 25 NOUN 26, ENTER
- f. 00001, ENTER
- g. 01600, ENTER
- h. 00003, ENTER
- i. VERB 31, ENTER

The RESTART lamps on the MDC and LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROW I shall indicate 00000.

**6.2.2.3.2** Press the ERROR RESET pushbutton on the K-START. The RESTART & PGNS caution lamps shall extinguish.

**6.2.2.3.3** Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

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### 6.2.2.8 TC Trap Test

6.2.2.8.1 Enter the following sequence into the K-Start. Press the ENTER pushbutton after each entry.

- a. VERB 21 NOUN 02, ENTER
- b. 01600, ENTER
- c. 01600, ENTER
- d. VERB 25 NOUN 26, ENTER
- e. 04000, ENTER
- f. 01600, ENTER
- g. 00003, ENTER
- h. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate. The PWS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROW 1 shall indicate 00000.

6.2.2.8.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PWS caution lamps shall extinguish.

6.2.2.8.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

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|        |                 |  |  |  |  |  |  |  |      |
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# 6.2.2.0 Nightwatchman Test

6.2.2.0.1 Enter the following sequence into the K-Start. Press ENTER pushbutton after each entry.

- a. VERB 24 NOUN 01, ENTER
- b. 01600, ENTER
- c. 30001, ENTER
- d. 01600, ENTER
- e. VERB 25 NOUN 26, ENTER
- f. 04000, ENTER
- g. 01600, ENTER
- h. 00003, ENTER
- i. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate. The FGMS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on MDC and LEB CMC DSKY and ROW 1 shall indicate 00000.

6.2.2.0.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & FGMS caution lamps shall extinguish.

6.2.2.0.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

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6.2.4.5 Record the voltage indicated on the CRT for the following power supplies:

- a. The +120 VDC PIPA Power Supply output voltage shall be  $120 \pm 6$  VDC (CG 1040).
- b. The +20 VDC PIPA Power Supply output voltage shall be  $20.0 \pm 1.2$  VDC (CG 1051).
- c. The -20 VDC PIPA Power Supply output voltage shall be  $-20 \pm 2$  VDC (CG 1052).
- d. The -28 VDC Electronics Power Supply output voltage shall be  $-28.5 \pm 6.0$  VDC (CG 1100).

6.2.4.6 The following values shall be measured with the guidance reference clock synchronizing input pulse. Record the voltage indicated on the CRT.

- a. IMU 28V, 800 CPS 1% 0 deg. voltage shall be  $28.0 \pm 0.6$  VAC (CG 1201).
- b. IMU 28V, 800 CPS, 5% PHA - 90 deg. voltage shall be  $28.0 \pm 1.4$  VAC (CG 1202).
- c. IMU 28V, 800 CPS, 5% PHB 0 deg. voltage shall be  $28.0 \pm 2.1$  VAC (CG 1203).
- d. Optics 28V, 800 CPS 1% 0 deg. voltage shall be  $28.0 \pm 0.6$  VAC (CG 1211).
- e. Optics 28V, 800 CPS 5% - 90 deg. voltage shall be  $28.0 \pm 1.5$  VAC (CG 1212).
- f. PH DIFF IMU 5% 0 deg. -90 deg. (CG 1207) phase difference shall be  $-90^\circ \pm 10^\circ$ .
- g. PH DIFF Optics 1% IMU 1% (CG1220) phase difference shall be  $0^\circ \pm 10^\circ$ .

6.2.4.7 Record the voltages indicated on the CRT for the following power supplies:

- a. The +14 VDC CMC Power Supply output voltage shall be  $+14.0 \pm 0.4$  VDC (CG 1020).
- b. The +4 VDC CMC Power Supply output voltage shall be  $+4.0 \pm 0.2$  VDC (CG 1030).
- c. The +4 VDC CDU Power Supply output voltage shall be  $+4.0 \pm 0.2$  VDC (CG 1070).
- d. The +2.5 VDC TM BIAS SUPPLY output voltage shall be  $+2.50 \pm 0.06$  VDC (CG 1110).

6.2.4.8 Record the CRT indications for the following measurements:

- a. The 28V, 3200 CPS Power Supply feedback output voltage shall be  $28.6 \pm 0.6$  VRMS (CG 1331).
- b. The phase difference between the 3.2Kc supply and CMC sync shall be  $0^\circ \pm 10^\circ$  (CG 1336).
- c. The +14 VDC CMC power Supply RMS noise shall be less than 0.2 VRMS (CG 1331).
- d. The +4 VDC CMC Power Supply rms noise shall be less than 0.2 VRMS (CG 1331).

- 6.2.9.1.3 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Record the indication on the CRT. Verify that OPTX 28V 800 cps 1% Oph (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.
- 6.2.9.1.4 Enter VERB 57 into K148. Press the ENTER pushbutton.
- 6.2.9.1.5 Enter 00010 into K148. Press the ENTER pushbutton.
- 6.2.9.1.6 Observe VERB 06 NOUN 01 flashes on the CRT and the PROGRAM display indicates 07.
- 6.2.9.2 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 30 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 02 flashing
  - b. R1 = +00000±00007
  - c. R2 = +00000±00007
  - d. R3 = +00000±00007
  - e. IG angle = 000±1 deg.
  - f. MG angle = 000±1 deg.
  - g. OG angle = 000±1 deg.
- 6.2.9.3 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 03 flashing
  - b. R1 = +04500±00007
  - c. R2 = +04500±00007
  - d. R3 = +04500±00007
  - e. IG angle = 045±1 deg.
  - f. MG angle = 045±1 deg.
  - g. OG angle = 045±1 deg.
- 6.2.9.4 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall extinguish. After approximately 100 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 30 flashing
  - b. R1 = 00000±00003
  - c. R2 = 00000±00003
  - d. R3 = 00000±00003

NOTE: Negative numbers will be displayed in octal complement form, i.e.,  
00001 = 77776.

6.2.9.18 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 66 flashing
- b. R1 = 000xx
- c. R2 = xxxxx

The GIMBAL LOCK lamp on the DSKY's shall extinguish. The PGNS caution lamp on the Indicator Control Panel shall extinguish.

Record R1 and R2 as the Inner Gimbal CDU drive rate.

IG rate =  $\frac{R1}{1442} \cdot \frac{R2}{1442}$  /sec. The Inner Gimbal CDU drive rate shall be 1442"/sec.

6.2.9.19 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 66 flashing
- b. R1 = 000xx
- c. R2 = xxxxx

Record R1 and R2 as the Outer Gimbal CDU drive rate. OG rate =  $\frac{R1}{1442} \cdot \frac{R2}{1442}$  . The Outer Gimbal CDU drive rate shall be 1442"/sec.

6.2.9.20 Enter VERB 33 into K-148. Press the ENTR pushbutton. The No ATT lamp on the DSKY's shall extinguish. After approximately 20 seconds, VERB 21 NOUN 22 shall flash on the CRT. Enter +00100 into K-148 three times. Press the ENTR pushbutton after each entry. The NO ATT lamp on the DSKY's shall momentarily light, then extinguish. After approximately 100 seconds, VERB 01 NOUN 10 flashing shall be displayed on the CRT. Verify R1 = 33XXX.

The ISS Warning lamp on the Indicator Control Panel shall light.

The ISS WARNING and ISS CDU FAIL discretes shall be ON.

6.2.9.21 Enter the following sequence manually per Steps 6.2.9.21.1.1 and 6.2.9.21.1.2 or tape load the sequence per Step 6.2.9.21.2.

6.2.9.21.1 Manually loaded input.

6.2.9.21.1.1 On K-148 enter

|         |         |      |
|---------|---------|------|
| VERB 25 | NOUN 26 | ENTR |
| 00001   |         | ENTR |
| 01300   |         | ENTR |
| 30005   |         | ENTR |
| VERB 31 |         | ENTR |

6.2.9.21.1.2 Proceed to 6.2.9.21.3 after manual entry of above data.

6.2.9.21.2 Tape loaded input.

6.2.9.21.2.1 Start tape reader at tape section 00102.

6.2.9.21.2.2 When tape reader stops, verify the following on the CRT:

R1 - 00102.

6.2.9.21.3 On K-148 enter VERB 33 ENTR. ISS WARNING and ISS CDU FAIL shall be OFF. After approximately 20 seconds VERB 21 NOUN 22 shall flash on the CRT. Enter +03375 into K-148 three times. Press the ENTR pushbutton after each entry. The NO ATT lamp on the DSKY's shall momentarily light, then extinguish. After approximately 100 seconds, VERB 01 NOUN 10 flashing shall be displayed on the CRT.

Verify R1 - 33XXX.

The ISS Warning lamp on the Indicator Control Panel shall light. The ISS WARNING and ISS CDU FAIL discretes shall be ON.



- 6.2.12.6.16 Set the OPTICS TEL TRUN switch to SLAVE TO SXT. Set the OPTICS ZERO switch to OFF.
- 6.2.12.7 SXT Parallelism Tests
- 6.2.12.7.1 Using the OPTICS CONTROL STICK drive the SXT StLOS Trunnion to  $+15.000 \pm 2$  degree as indicated in R2 of the DSKY. Maintain a Shaft CDU angle of  $000.00 \pm 0.10$  degree as indicated by R1 on the DSKY.
- 6.2.12.7.2 Sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to superimpose the SXT LLOS horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.
- 6.2.12.7.3 Repeat 6.2.12.7.2 twice. Calculate and record the average of the three autocollimator readings.
- 6.2.12.7.4 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within  $\pm 5$  degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO.
- 6.2.12.7.5 Again sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to bring the SXT StLOS horizontal reticle and autocollimator horizontal filar images to coincide. Record the autocollimator reading.
- 6.2.12.7.6 Repeat 6.2.12.7.5 twice. Calculate and record the average of the three autocollimator readings. The average value obtained here shall not differ from that obtained in 6.2.12.7.3 by more than 10 arc-seconds.
- 6.2.12.7.7 Deleted.
- 6.2.12.7.8 Deleted.
- 6.2.12.7.9 Remove the Portable Light Assembly and Adapter Assembly from the base of the SXT eyepiece. Replace the SXT eyepiece plug.
- NOTE: If Optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.
- 6.2.12.8 Shaft and Trunnion Positional Accuracy Checks
- 6.2.12.8.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within  $\pm 5$  degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. After 15 seconds, return the selector to OFF.
- 6.2.12.8.2 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton.

- 6.2.16.7.59 On K-148 enter the following sequence:

VERB 33 ENTR

- 6.2.16.7.60 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R2  $\boxed{707}$  (NBDY-NBDX) + .5 (ADLAX-ADLAX) +.5 ADGRA  $\boxed{X}$  Position +00010.

- 6.2.16.7.61 Terminate this test by entering in K-148 the following:

VERB 36 ENTR

- 6.2.16.7.62 On K-148 enter the following sequence:

VERB 41 NOUN 20 ENTR

+00000 ENTR

+00000 ENTR

+00000 ENTR

- 6.2.16.9 Y PIPA Data Correction Calculation

- 6.2.16.9.1 From the uplink file tape, the compressed data tape, or the PCM tape, request a data reduction of the X and Z accelerometer  $\Delta V$  counts (addresses 37 and 41, respectively) and the TIME 2 and TIME 1 registers (addresses 24 and 25, respectively) for the period during which the Y PIPA test was being performed in positions 5 and 6 of the IMU Performance Test.

- 6.2.16.9.2 Perform the following calculations for position 5.

$$G'_5 = \frac{G_5}{\cos \theta_{y5}}$$

Where:

$G_5$  = Measured acceleration term (position 5).

$G'_5$  = Corrected acceleration term (transfer to line 11)

$$\cos \theta_{y5} = 1 - \frac{\theta_{y5}^2}{2} \quad \text{for small angles}$$

Where:

$$\theta_{y5} = \sqrt{\theta_{x5}^2 + \theta_{z5}^2}$$

and:

$$\theta_{z5} = \frac{(\Delta V_{z5} - \Delta V_{z5} \text{ Bias}) (S.F._z)}{(\Delta T) (\text{local } g)}$$

$$\theta_{x5} = \frac{(\Delta V_{x5} - \Delta V_{x5} \text{ Bias}) (S.F._x)}{(\Delta T) (\text{local } g)}$$

and:

$$\Delta V_x \text{ Bias} = \frac{(\text{X PIPA Bias}) (\Delta T)}{S.F._x}$$

$$\Delta V_z \text{ Bias} = \frac{(\text{Z PIPA Bias}) (\Delta T)}{S.F._z}$$

S.F. and Bias terms are obtained from positions 1 through 4 of the IMU Performance Test.

### 6.2.16.9.3

Perform the following calculations for position 6.

$$G'_6 = \frac{G_6}{\cos \theta_{y_6}}$$

Where:

$G_6$  = Measured acceleration term (position 6)

$G'_6$  = Corrected acceleration term (transfer to line 12)

$$\cos \theta_{y_6} = 1 - \frac{\theta^2_{y_6}}{2} \text{ for small angles}$$

$$\theta_{y_6} = \sqrt{\theta^2_{x_6} + \theta^2_{z_6}}$$

and:

$$\theta_{z_6} = \frac{(\Delta V_{x6} - \Delta V_x \text{ Bias}) (S.F._x)}{(\Delta T) (\text{local } g)}$$

$$\theta_{x_6} = \frac{(\Delta V_{z6} - \Delta V_z \text{ Bias}) (S.F._z)}{(\Delta T) (\text{local } g)}$$

and:

$$\Delta V_x \text{ Bias} = \frac{(\text{X PIPA Bias}) (\Delta T)}{S.F._x}$$

$$\Delta V_z \text{ Bias} = \frac{(\text{Z PIPA Bias}) (\Delta T)}{S.F._z}$$

S.F. and Bias terms are obtained from positions 1 through 4 of the IMU Performance Test.

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6.2.16.10 Calculations

Table XXI

| Position No. As<br>Displayed in R3 | Quantity Being Measured                                           |
|------------------------------------|-------------------------------------------------------------------|
| +00001                             | +NBDY<br>+X PIPA G                                                |
| +00002                             | +NBDZ<br>-X PIPA G<br>-NBDK + ADIAX                               |
| +00003                             | -NBDK<br>+Z PIPA G                                                |
| +00004                             | +NBDY + ADERAY<br>-Z PIPA G<br>+NBDZ + ADIAZ                      |
| +00005                             | + Y PIPA G                                                        |
| +00006                             | - Y PIPA G                                                        |
| +00007                             | -NBDK + .707 ADERAX                                               |
| +00008                             | .707 (-NBDZ - NBDY) + .5 (ADIAZ - ADIAX)<br>+.5 (ADERAY + ADERAZ) |
| +00009                             | -NBDZ + .707 ADERAZ                                               |
| +00010                             | .707 (NBDY - NBDK) + .5 (ADIAX - ADIAX)<br>+.5 (ADERAX)           |

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| <u>Line</u>    | <u>Position No.</u> | <u>Step No.</u> | <u>Parameter</u>                                                              | <u>Recorded Value</u> |
|----------------|---------------------|-----------------|-------------------------------------------------------------------------------|-----------------------|
| 6.2.16.10.1.1  | 1                   | +00001          | 6.2.16.7.10 +NBDY                                                             | R2                    |
| 6.2.16.10.1.2  | 2                   | +00001          | 6.2.16.7.11 +XPIFAG                                                           | R1 . R2               |
| 6.2.16.10.1.3  | 3                   | +00002          | 6.2.16.7.10 +NBDZ                                                             | R2                    |
| 6.2.16.10.1.4  | 4                   | +00002          | 6.2.16.7.10 -XPIFAG                                                           | R1 . R2               |
| 6.2.16.10.1.5  | 5                   | +00002          | 6.2.16.7.20 -NBDX +<br>ADIAK                                                  | R2                    |
| 6.2.16.10.1.6  | 6                   | +00003          | 6.2.16.7.24 -NBDX                                                             | R2                    |
| 6.2.16.10.1.7  | 7                   | +00003          | 6.2.16.7.20 +ZPIFAG                                                           | R1 . R2               |
| 6.2.16.10.1.8  | 8                   | +00004          | 6.2.16.7.20 +NBDY +<br>ADSRAY                                                 | R2                    |
| 6.2.16.10.1.9  | 9                   | +00004          | 6.2.16.7.20 -ZPIFAG                                                           | R1 . R2               |
| 6.2.16.10.1.10 | 10                  | +00004          | 6.2.16.7.24 +NBDZ +<br>ADIAZ                                                  | R2                    |
| 6.2.16.10.1.11 | 11                  | +00005          | 6.2.16.7.20 and +YPIFAG                                                       | R1 . R2               |
| 6.2.16.10.1.12 | 12                  | +00006          | 6.2.16.7.24 and -YPIFAG                                                       | R1 . R2               |
| 6.2.16.10.1.13 | 13                  | +00007          | 6.2.16.7.20 -NBDX +<br>.707ADGRAK                                             | R2                    |
| 6.2.16.10.1.14 | 14                  | +00008          | 6.2.16.7.20 .707 (-NBDZ-<br>NBDY) + .5 (ADIAZ-ADIAK)<br>+.5 (ADSRAY + ADGRAZ) | R2                    |
| 6.2.16.10.1.15 | 15                  | +00009          | 6.2.16.7.24 -NBDZ +<br>.707ADGRAZ                                             | R2                    |
| 6.2.16.10.1.16 | 16                  | +00010          | 6.2.16.7.20 .707(NBDY -<br>NBDX) + .5 (ADIAZ -<br>ADIAK) + .5 ADGRAK          | R2                    |

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6.2.16.10.2 Obtain data from last historical IRIG and PIPA test and complete Table X<sub>1-1</sub>.

TABLE X<sub>1-1</sub>

| PARAMETER          | UNITS               | RECORDED VALUE |
|--------------------|---------------------|----------------|
| NBDX               | meru                |                |
| NBDY               | meru                |                |
| NBDZ               | meru                |                |
| ADSRAX             | meru/g              |                |
| ADSRAY             | meru/g              |                |
| ADSRAZ             | meru/g              |                |
| ADIAX              | meru/g              |                |
| ADIAZ              | meru/g              |                |
| X PIPA S. F. Error | PPM                 |                |
| Y PIPA S. F. Error | PPM                 |                |
| Z PIPA S. F. Error | PPM                 |                |
| X PIPA Bias        | cm/sec <sup>2</sup> |                |
| Y PIPA Bias        | cm/sec <sup>2</sup> |                |
| Z PIPA Bias        | cm/sec <sup>2</sup> |                |

6.2.16.10.3 Obtain data from the second last historical IRIG and PIPA test and complete Table X<sub>1-2</sub>.

TABLE X<sub>1-2</sub>

| PARAMETER | UNITS  | RECORDED VALUE |
|-----------|--------|----------------|
| NBDX      | meru   |                |
| NBDY      | meru   |                |
| NBDZ      | meru   |                |
| ADSRAX    | meru/g |                |
| ADSRAY    | meru/g |                |
| ADSRAZ    | meru/g |                |
| ADIAX     | meru/g |                |

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TABLE X<sub>1-2</sub> (Continued)

| PARAMETER          | UNITS               | RECORDED VALUE |
|--------------------|---------------------|----------------|
| ADIA Y             | meru/g              |                |
| ADIA Z             | meru/g              |                |
| X PIPA S. F. Error | PPM                 |                |
| Y PIPA S. F. Error | PPM                 |                |
| Z PIPA S. F. Error | PPM                 |                |
| X PIPA Bias        | cm/sec <sup>2</sup> |                |
| Y PIPA Bias        | cm/sec <sup>2</sup> |                |
| Z PIPA Bias        | cm/sec <sup>2</sup> |                |

6.2.16.10.4 Obtain data from the third last historical IRIG and PIPA test and complete Table X<sub>1-3</sub>.

TABLE X<sub>1-3</sub>

| PARAMETER          | UNITS               | RECORDED VALUE |
|--------------------|---------------------|----------------|
| NBDX               | meru                |                |
| NBDY               | meru                |                |
| NBDZ               | meru                |                |
| ADGRAX             | meru/g              |                |
| ADGRAY             | meru/g              |                |
| ADGRAZ             | meru/g              |                |
| ADIA X             | meru/g              |                |
| ADIA Y             | meru/g              |                |
| ADIA Z             | meru/g              |                |
| X PIPA S. F. Error | PPM                 |                |
| Y PIPA S. F. Error | PPM                 |                |
| Z PIPA S. F. Error | PPM                 |                |
| X PIPA Bias        | cm/sec <sup>2</sup> |                |
| Y PIPA Bias        | cm/sec <sup>2</sup> |                |
| Z PIPA Bias        | cm/sec <sup>2</sup> |                |

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6.2.16.10.5 Compute the PIPA Scale Factor error in parts per million and record in Table X.

$$\begin{aligned} \text{a. PIPA S. F. Error} &= \left[ \frac{(2 \text{ local g})}{+PIPAG - (-PIPAG)} - 1.000000 \right] 10^6 \\ \text{b. X PIPA S. F. Error} &= \left[ \frac{(2 \text{ local g})}{\text{line 2} - \text{line 4}} - 1.000000 \right] 10^6 \\ \text{c. Y PIPA S. F. Error} &= \left[ \frac{(2 \text{ local g})}{\text{line 11} - \text{line 12}} - 1.000000 \right] 10^6 \\ \text{d. Z PIPA S. F. Error} &= \left[ \frac{(2 \text{ local g})}{\text{line 7} - \text{line 9}} - 1.000000 \right] 10^6 \end{aligned}$$

The PIPA S. F. Error shall not exceed  $\pm 1900$  PPM.

6.2.16.10.6 Compute the PIPA Bias in  $\text{cm/sec}^2$  and record in Table X<sub>1</sub>.

$$\begin{aligned} \text{a. PIPA Bias} &= \frac{+PIPAG + (-PIPAG)}{2} = \text{--- cm/sec}^2 \\ \text{b. X PIPA Bias} &= \frac{\text{line 2} + \text{line 4}}{2} = \text{---} \\ \text{c. Y PIPA Bias} &= \frac{\text{line 11} + \text{line 12}}{2} = \text{---} \\ \text{d. Z PIPA Bias} &= \frac{\text{line 7} + \text{line 9}}{2} = \text{---} \end{aligned}$$

The PIPA Bias shall not exceed  $\pm 2.36 \text{ cm/sec}^2$ .

6.2.16.10.7 Calculate NBD, ADGRA, and ADIA and record in Table X<sub>1</sub>.

$$\begin{aligned} \text{a. NBDX} &= -(\text{line 6}) = \text{---} \\ \text{NBDY} &= \text{line 1} = \text{---} \\ \text{NBDZ} &= \text{line 3} = \text{---} \\ \text{NBD} &\text{ shall not exceed } \pm 15 \text{ meru.} \end{aligned}$$

$$\text{b. ADGRAX} = \frac{(\text{line 13} - \text{line 6})}{.707} = \text{---}$$

$$\text{ADGRAY} = \text{line 8} - \text{line 1} = \text{---}$$

$$\text{ADGRAZ} = \frac{\text{line 15} + \text{line 2}}{.707} = \text{---}$$

ADGRA shall not exceed  $\pm 40 \text{ meru/g.}$



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c. ADIAX = line 5 - line 6

$$ADIAI = \frac{\text{line 16} - .797(\text{NBDY} - \text{NBDX})}{.5} - \text{ADSRAX} + \text{ADIAZ}$$

ADIAZ = line 10 - line 3

ADIA shall not exceed  $\pm 100$  meru/g.

TABLE X<sub>1</sub>

| PARAMETER          | UNITS               | CALCULATED VALUE |
|--------------------|---------------------|------------------|
| NBDX               | meru                |                  |
| NBDY               | meru                |                  |
| NBDZ               | meru                |                  |
| ADSRAX             | meru/g              |                  |
| ADSRAY             | meru/g              |                  |
| ADSRZ              | meru/g              |                  |
| ADIAI              | meru/g              |                  |
| ADIAZ              | meru/g              |                  |
| X PIPA S. F. Error | PPM                 |                  |
| Y PIPA S. F. Error | PPM                 |                  |
| Z PIPA S. F. Error | PPM                 |                  |
| X PIPA Bias        | cm/sec <sup>2</sup> |                  |
| Y PIPA Bias        | cm/sec <sup>2</sup> |                  |
| Z PIPA Bias        | cm/sec <sup>2</sup> |                  |

6.2.16.10.8 Perform the following calculations for each term in Table X<sub>1</sub>, and record the results in Table D.

$$D_1 = |X_{t-1} - X_t|$$

$$D_2 = |X_{t-1} - X_t| + |X_{t-2} - X_{t-1}|$$

$$D_3 = |X_{t-3} - X_{t-2}| + |X_{t-2} - X_{t-1}| + |X_{t-1} - X_t|$$

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$X_1$  = data point just obtained  
 $X_{i-1}$  = last historical data point  
 $X_{i-2}$  = second last historical data point  
 $X_{i-3}$  = third last historical data point

NOTE:  $D_1$  calculations begin with the first data point after ISS Pre-Vib;  $D_2$  calculations begin with the second data point after ISS Pre-Vib;  $D_3$  calculations begin with the third data point after Pre-Vib.

TABLE D

| PARAMETER          | UNITS               | $D_1$ | MAX | $D_2$ | MAX | $D_3$ | MAX |
|--------------------|---------------------|-------|-----|-------|-----|-------|-----|
| NBDX               | meru                |       | 6   |       | 9   |       | 11  |
| NBDY               | meru                |       | 6   |       | 9   |       | 11  |
| NBDZ               | meru                |       | 6   |       | 9   |       | 11  |
| ADSRAX             | meru/g              |       | 14  |       | 21  |       | 25  |
| ADSRAY             | meru/g              |       | 14  |       | 21  |       | 25  |
| ADSRAZ             | meru/g              |       | 14  |       | 21  |       | 25  |
| ADMAX              | meru/g              |       | 17  |       | 33  |       | 40  |
| ADMAX              | meru/g              |       | 17  |       | 33  |       | 40  |
| ADMAX              | meru/g              |       | 17  |       | 33  |       | 40  |
| X PIPA S. F. Error | PPM                 |       | 400 |       | 500 |       | 600 |
| Y PIPA S. F. Error | PPM                 |       | 400 |       | 500 |       | 600 |
| Z PIPA S. F. Error | PPM                 |       | 400 |       | 500 |       | 600 |
| X PIPA Bias        | cm/sec <sup>2</sup> |       | 0.5 |       | 0.7 |       | 0.9 |
| Y PIPA Bias        | cm/sec <sup>2</sup> |       | 0.5 |       | 0.7 |       | 0.9 |
| Z PIPA Bias        | cm/sec <sup>2</sup> |       | 0.5 |       | 0.7 |       | 0.9 |

6.2.16.10.9 Failure to meet the above criteria shall result in retest according to paragraph 5.4.2.

6.2.17 EXT-NB-IMU Fine Alignment Test

6.2.17.1 Perform Master Initialization 6.2.5.3 before proceeding.

6.2.17.2 Prior to performing this test, the G&N Installation Qualification fixture shall be installed on the supporting fixture and adjusted to permit proper operation of the G&N optics. The azimuth supplied by the azimuth autoset (Optical Reference No. 1) shall be known to  $\pm 30$  minutes of arc.

NOTE: The G&N shall have had OPERATE power applied for a minimum of 1 hour. Set the G/N POWER-OPTICS switch to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0 $\pm$ 3.0 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.

6.2.17.3 Enter VERB 01 NOUN 10 into KI48. Press the ENTER pushbutton. Enter 00003 into KI48. Press the ENTER pushbutton. Record R1 = AAAAA.

If the recorded value is within any of the sets of limits given in Table 1 proceed with the test. If the recorded value is NOT within any of the sets of limits wait 30 minutes and then repeat this step.

TABLE I

| MIN VALUE |           | MAX VALUE |  |
|-----------|-----------|-----------|--|
| 00000     | < AAAAA < | 03242     |  |
| 04000     | < AAAAA < | 07242     |  |
| 10000     | < AAAAA < | 13242     |  |
| 14000     | < AAAAA < | 17242     |  |
| 20000     | < AAAAA < | 23242     |  |
| 24000     | < AAAAA < | 27242     |  |
| 30000     | < AAAAA < | 33242     |  |
| 34000     | < AAAAA < | 37242     |  |

6.2.17.4 Enter the following sequence into the Lower Equipment Bay (LEB) DSKY.

- a. VERB 41 NOUN 20 ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.17.5 On the G&N Indicator Control Panel set the following switches to the position indicated.

- a. OPTICS TEL TRUN to SLAVE to EXT
- b. OPTICS COUPLING to DIRECT
- c. OPTICS SPEED to LO
- d. OPTICS MODE to MAN

6.2.17.5.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the EXT Trunnion to within  $\pm 5$  degrees of zero as indicated by the TPAC. Set OPTICS ZERO to ZERO.

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- 6.2.17.6 Enter the following into the DSKY.
- a. VERB 01 NOUN 01, ENTER
  - b. 00362, ENTER
  - Record R1 = XXXXY
- 6.2.17.7 Enter the following into the DSKY
- a. VERB 21 NOUN 01, ENTER
  - b. 00362, ENTER
  - c. XXXXY', ENTER where Y' is determined by Table II and XXXX is that recorded in 6.2.17.9.

TABLE II

| Y (From 6.2.17.9) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|-------------------|---|---|---|---|---|---|---|---|
| Y'                | 2 | 2 | 2 | 2 | 2 | 7 | 6 | 7 |

- 6.2.17.8 Initiate the test by entering the following sequence into the LEB DSKY.
- a. VERB 57, ENTER
  - b. 00003, ENTER
- 6.2.17.9 Observe VERB 06 NOUN 01 flashing on the DSKY. The following data is displayed in R1 and R2 on the DSKY.
- a. R1 = +13500
  - b. R2 = +xx.xxx (Site Latitude from Table I)

TABLE I

| Test Site | Latitude |
|-----------|----------|
| NAA       | +33.923  |
| MILA      | +28.516  |
| MSC       | +29.566  |

- 6.2.17.10 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If the value displayed is other than +13500 in R1 and the correct Site Latitude in R2, correct the data by entering the following sequence into the DSKY.
- a. VERB 21, ENTER
  - b. +13500, ENTER
  - c. VERB 22, ENTER
  - d. +xx.xxx, ENTER (+xx.xxx = Site Latitude from Table I)
  - e. VERB 33, ENTER
- 6.2.17.11 Observe VERB 21 NOUN 30 flashing on the DSKY. Enter the following sequence into the DSKY.
- a. +00001, ENTER (Position Number)
  - b. +00000, ENTER
  - c. +00001, ENTER

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- 6.2.17.13 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +XXX.XX (Y<sub>NB</sub> Azimuth)
  - R2 = +XX.XXX (Y<sub>NB</sub> Elevation)
  - R3 = 00001
- 6.2.17.13 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct Y<sub>NB</sub> azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
  - +XXX.XX ± 002.00 degrees, ENTER (Y<sub>NB</sub> azimuth)
  - +XX.XXX ± 02.000 degrees, ENTER (Y<sub>NB</sub> elevation)
  - VERB 33, ENTER
- 6.2.17.14 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +XXX.XX (Z<sub>NB</sub> Azimuth)
  - R2 = +XX.XXX (Z<sub>NB</sub> Elevation)
  - R3 = 00003
- 6.2.17.15 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct Z<sub>NB</sub> azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
  - +XXX.XX ± 002.00 degrees, ENTER (Z<sub>NB</sub> Azimuth)
  - +XX.XXX ± 02.000 degrees, ENTER (Z<sub>NB</sub> elevation)
  - VERB 33, ENTER
- 6.2.17.16 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +XXX.XX (Target 1 Azimuth)
  - R2 = +XX.XXX (Target 1 Elevation)
  - R3 = 00001
- 6.2.17.17 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct azimuth and elevation for Target 1, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
  - +XXX.XX ± 000.10 degrees, ENTER (Target 1 Azimuth)
  - +XX.XXX ± 00.010 degrees, ENTER (Target 1 Elevation)
  - VERB 33, ENTER
- 6.2.17.16 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +XXX.XX (Target 2 Azimuth)
  - R2 = +XX.XXX (target 2 Elevation)
  - R3 = 00003

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- 6.2.17.19 If the data displayed is correct proceed to 6.2.17.20. If R1 and R2 do not contain the correct azimuth and elevation for Target 2, correct the data by entering the following sequence into the DSKY.
- a. VERB 24, ENTER
  - b. XXXX.XXX000.10 degrees, ENTER (Target 2 Azimuth)
  - c. XXX.XXX000.010 degrees, ENTER (Target 2 Elevation)
- 6.2.17.20 Set the OPTICS ZERO switch to OFF. Enter VERB 33, ENTER into the DSKY.
- 6.2.17.21 When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00001, set the OPTICS MODE switch on the G&N Indicator Control Panel to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.
- 6.2.17.22 Using the Optics Band Controller, align the SXT StLOS with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.23 When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00002 set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.
- 6.2.17.24 Using the Optics Hand Controller, align the SXT StLOS with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.
- NOTE: The following two MARKS must be performed as quickly as possible. In no case shall the time between the first and second MARK exceed two minutes.
- 6.2.17.25 After 90 seconds observe the DSKY for VERB 51 NOUN 30 flashing and R1 = 00001. Set the Optics Mode switch to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.
- 6.2.17.26 Using the Optics Hand Controller, align the SXT StLOS with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.

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- 6.2.17.27 When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00002 set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.
- 6.2.17.28 Using the Optics Hand Controller, align the SXT S&LOS with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.29 Repeat steps 6.2.17.20 through 6.2.17.27.
- 6.2.17.30 In approximately 7 minutes VERB 06 NOUN 66 shall flash on the DSKY and the test results shall be displayed. R1 and R2 on the DSKY shall display the misalignment of one of the horizontal PIPA's in arc seconds (R1 = whole, R2 = fractional). Record R1 and R2. (See Table II for PIPA displayed).
- 6.2.17.30 Enter VERB 33 ENTER into the DSKY. When VERB 06 NOUN 66 flashes, R1 and R2 on the DSKY shall display the misalignment of the second horizontal PIPA in arc seconds (R1 whole, R2 fractional). (See Table II for PIPA displayed.) Record R1 and R2.
- 6.2.17.31 Enter VERB 34 ENTER into the DSKY to terminate the test. Wait 5 seconds.
- 6.2.17.32 Repeat steps 6.2.17.3 and 6.2.17.8 through 6.2.17.31 substituting No. 00002 in 6.2.17.11.a.
- 6.2.17.33 Enter the following into the DSKY.
- a. VERB 36, ENTER
  - b. VERB 41 NOUN 20, ENTER
  - c. +00000, ENTER
  - d. +00000, ENTER
  - e. +00000, ENTER

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Table II. Display Conditions at Test Completion

| Position | SM Orientation |          |          | Horizontal Misalignment Component |           |
|----------|----------------|----------|----------|-----------------------------------|-----------|
|          | $X_{SM}$       | $Y_{SM}$ | $Z_{SM}$ | 6.2.17.20                         | 6.2.17.20 |
| 1        | UP             | SW       | SE       | $Y_{SM}$                          | $Z_{SM}$  |
| 2        | SE             | SW       | EN       | $X_{SM}$                          | $Y_{SM}$  |
| 3*       | SE             | UP       | SW       | $X_{SM}$                          | $Z_{SM}$  |

\* Position 3 is not run in the Spacecraft because of GEMBAL LOCK considerations.

6.2.17.24 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.17.26 Calculations

- 6.2.17.26.1
- $Y_{SM}$  misalignment = ( )  $\frac{R1-R2}{R1+R2}$
  - $Z_{SM}$  misalignment = ( )  $\frac{R1-R2}{R1+R2}$
  - $X_{SM}$  misalignment = ( )  $\frac{R1-R2}{R1+R2}$
  - $Y_{SM}$  misalignment = ( )  $\frac{R1-R2}{R1+R2}$

6.2.17.26.2 Enter the latest values from 6.2.16 IMU Performance Test.

- X PIPA bias = \_\_\_\_\_ cm/sec<sup>2</sup>
- Y PIPA bias = \_\_\_\_\_ cm/sec<sup>2</sup>
- Z PIPA bias = \_\_\_\_\_ cm/sec<sup>2</sup>
- $\theta_x = 210$  (X PIPA bias) = \_\_\_\_\_ arc sec.
- $\theta_y = 210$  (Y PIPA bias) = \_\_\_\_\_ arc sec.
- $\theta_z = 210$  (Z PIPA bias) = \_\_\_\_\_ arc sec.

- 6.2.17.26.3
- $Y_{SM}$  misalignment (Bias corrected) = 6.2.17.26.1a -  $\theta_y$  = \_\_\_\_\_ arc sec.
  - $Z_{SM}$  misalignment (Bias corrected) = 6.2.17.26.1b -  $\theta_z$  = \_\_\_\_\_ arc sec.
  - $X_{SM}$  misalignment (Bias corrected) = 6.2.17.26.1c -  $\theta_x$  = \_\_\_\_\_ arc sec.
  - $Y_{SM}$  misalignment (Bias corrected) = 6.2.17.26.1d -  $\theta_y$  = \_\_\_\_\_ arc sec.

The SM misalignments in each orientation, including PIPA bias, shall not exceed ±180 arc seconds.

6.2.18 Gyrocompassing Test

NOTE: Perform Master Initialization 6.2.5.3 before proceeding.

- 6.2.18.1 Set the G/N POWER-OPTICS Switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Verify that OPTX 28V 800 ops 1% zero (CG 1211) and OPTX 28V 800 ops 5%- 90%h (CG 1212) are not flashing on the CRT.



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6.2.18.2 Enter the following into the DSKY.

- a. VERB 01 NOUN 01, ENTER
- b. 00362, ENTER
- Record R1 = XXXXY

6.2.18.3 Enter the following into the DSKY.

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table II and XXXX is that recorded in 6.2.18.2.

Table II

| Y (From 6.2.18.2) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|-------------------|---|---|---|---|---|---|---|---|
| Y'                | 2 | 3 | 2 | 3 | 6 | 7 | 6 | 7 |

6.2.18.4 Enter the following sequence into the K-Start, pressing ENTER pushbutton after each entry.

- a. VERB 57, ENTER
- b. 00006, ENTER

6.2.18.5 System shall advance to Gyrocompass System Test and display 01 on the CRT program display.

6.2.18.6 On the CRT observe VERB 06, NOUN 01 flashing with some launch azimuth displayed in R1 = +XXX.XX.

6.2.18.6.1 If the azimuth displayed is correct proceed to 6.2.18.5; if not, perform the following sequence:

- a. VERB 21, Press ENTER pushbutton
- b. +XXX.XX, press ENTER pushbutton (Correct Launch Azimuth)

6.2.18.7 After verifying that the correct launch azimuth is displayed in R1 on the CRT, Enter VERB 33 on the K-START and push the ENTER pushbutton.

6.2.18.8 Observe VERB 06 NOUN 01 flashing on the CRT with the following displayed in R1 and R2.

- a. R1 = +XXX.XX, Nav. Base Azimuth ( $Z_{NB}$ )
- b. R2 = +XX.XXX, Site Latitude

6.2.18.8.1 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence:

To correct R1:

- a. VERB 21, ENTER
- b. +XXX.XX+000.50 degrees, ENTER ( $Z_{NB}$  Azimuth)

To correct R2:

- a. Verb 22, ENTER
- b. +XX.XXX, ENTER (Correct Site Latitude from Table I)

- 6.2.18.9.1 Enter the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SNT Trunnion to within  $\pm 5$  degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SNT). Between 175 minutes and 190 minutes from  $T_0$  set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.9 Gyrocompassing Stability
- 6.2.18.9.1 Enter VERB 33, ENTER into the DSKY. On the DSKY observe the PROGRAM display change to 05 after approximately 90 seconds. Approximately 5 minutes later observe the PROGRAM display change to 02. When PROG display changes to 02 record time as  $T_0$ .
- 6.2.18.9.2 120 minutes after  $T_0$  record the Outer, Inner and Middle CDU Gimbal angles from the CRT.
- 6.2.18.9.3 Repeat above step every 5 minutes for the next 60 minutes.
- 6.2.18.9.4 The peak-to-peak spread of the outer gimbal angle shall not exceed 0.12 degrees.
- 6.2.18.9.5 The peak-to-peak spread of the Inner and Middle gimbal angles shall not exceed 0.04 degrees.
- 6.2.18.10 Gyrocompassing Accuracy
- 6.2.18.10.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within  $\pm 5$  degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Between 175 minutes and 190 minutes from  $T_0$  set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.10.2 Enter the following into the DSKY.
- VERB 21 NOUN 03 ENTER
  - 02663 ENTER
  - +XXX.XX $\pm$ 000.01 ENTER (Target No. 1 Az)
  - Press ENTER Pushbutton
  - 02664 ENTER
  - +XXX.XX $\pm$ 000.01 ENTER (Target No. 2 Az)
  - Press ENTER Pushbutton
  - 02665 ENTER
  - +00.000 ENTER (Target No. 1 EL)
  - Press ENTER Pushbutton
  - 02666 ENTER
  - +00.000 ENTER (Target No. 2 EL)
- On the G&N Indicator Control Panel set the OPTICS ZERO switch to OFF, set the OPTICS MODE switch to MAN and the OPTICS SPEED switch to HI. Drive the SLOS to the approximate position of Target No. 1. Set the OPTICS SPEED Switch to LO.
- NOTE: Read the following 10 steps before proceeding. These are time critical steps and must be performed as rapidly as possible.
- 6.2.18.11 After 180 minutes from  $T_0$  enter VERB 33 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT change to 03.

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- 6.2.18.12** When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 1 azimuth and elevation.
- a. R1 = +xxx.xx (Target 1 azimuth)
  - b. R2 = +00.000 (Target 1 elevation)
- 6.2.18.13** Verify the data appearing in R1 and R2 and if correct, proceed. If not correct, perform the following sequence.
- a. VERB 24, ENTER
  - b. +xxx.xx±000.01, ENTER (Target 1 azimuth)
  - c. +00.000, ENTER (Target 1 elevation)
- 6.2.18.14** After the correct readings for R1 and R2 are verified, enter VERB 33 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.15** When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 2 azimuth and elevation.
- a. R1 = +xxx.xx (Target 2 azimuth)
  - b. R2 = +00.000 (Target 2 elevation)
- 6.2.18.16** Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence.
- a. VERB 24, ENTER
  - b. +xxx.xx±000.01, ENTER (Target 2 azimuth)
  - c. +00.000, ENTER (Target 2 elevation)

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- 6.2.18.17 After the correct readings for R1 and R2 are verified enter VERB 33 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.18 Using the Optics Hand Controller, align the EXT SLOS to target 1 and press the MARK pushbutton. If satisfied that the MARK was good, proceed. If not satisfied with MARK, press the MARK REJECT pushbutton and repeat the step.
- 6.2.18.19 Set the OPTICS SPEED switch to HI. Using the Optics Hand Controller, drive the EXT SLOS to the approximate position of Target No. 2.
- 6.2.18.20 Set the OPTICS SPEED switch to LO. Using the Optics Hand Controller, align the EXT SLOS to Target 2 and press the MARK pushbutton. If satisfied that the MARK was good, press the ENTER pushbutton. If not satisfied, press the MARK REJECT pushbutton and repeat this step.
- 6.2.18.21 On the CRT observe the following data displayed:
- a. VERB 06 NOUN 60
  - b. R1 = ±xx.xxx (X gyro elevation error, degrees)
  - c. R2 = ±xx.xxx (Y gyro elevation error, degrees)
  - d. R3 = ±xx.xxx (Z gyro azimuth error, degrees)
- Record R1, R2 and R3.
- 6.2.18.22 Enter VERB 34 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT and DSKY's indicate 02. Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the EXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to EXT). Set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.23 Enter VERB 34 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.24 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start three times. Press the ENTER pushbutton after each entry. Set the G/N POWER OPTICS Switch on the LEB Lighting Control Panel to OFF.

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6.2.18.25

Data Sheet

| TIME    | CDUX | CDUY | CDUZ |
|---------|------|------|------|
| To      |      |      |      |
| To +15  |      |      |      |
| To +30  |      |      |      |
| To +45  |      |      |      |
| To +60  |      |      |      |
| To +75  |      |      |      |
| To +90  |      |      |      |
| To +105 |      |      |      |
| To +120 |      |      |      |
| To +125 |      |      |      |
| To +130 |      |      |      |
| To +135 |      |      |      |
| To +140 |      |      |      |
| To +145 |      |      |      |
| To +150 |      |      |      |
| To +155 |      |      |      |
| To +160 |      |      |      |
| To +165 |      |      |      |
| To +170 |      |      |      |
| To +175 |      |      |      |
| To +180 |      |      |      |

- NOTES: 1. Record CDU angles at times indicated. ( $T_0$  is the time at the start of test - Prog 02)
2. The 2 hr data ( $T_0 + 120$  minutes) is baseline.

Tolerance: Tolerance is  $0.00 \pm 0.06^\circ$  delta from 2 hr baseline for CDUX, and  $0.00 \pm 0.03^\circ$  delta from 2 hr baseline for CDUY & CDUZ for the 120 minute to 180 minute recordings only.

| Line | Step      | Parameter              | Recorded Value   |
|------|-----------|------------------------|------------------|
| 1    | 6.2.18.21 | X Gyro Elevation Error | $\pm R1$ degrees |
| 2    |           | Y Gyro Elevation Error | $\pm R2$ degrees |
| 3    |           | Z Gyro Azimuth Error   | $\pm R3$ degrees |

6.2.18.26

Calculation Sheet

6.2.18.26.1

Record the most recent values of the following coefficients from 6.2.16, IMU Performance Test.

- a. NBDX = ( ) \_\_\_\_\_
- b. NBDY = ( ) \_\_\_\_\_
- c. NBDZ = ( ) \_\_\_\_\_
- d. ADIAZ = ( ) \_\_\_\_\_
- e. ADSRAY = ( ) \_\_\_\_\_

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6.2.18.26.2 Perform the following calculations. (Cos  $\lambda$  functions are provided in Table I.)

- a.  $D_{(vert)} = NBDZ + ADIAZ$   
 $D_{(vert)} = ( )$  \_\_\_\_\_ meru
- b.  $D_{(east)} = \sin (\text{Launch Az}) NBDX +$   
 $\cos (\text{Launch Az}) NBDY + ADSRAY$
- c.  $\phi_{(vert)} = \frac{D_{(vert)} \times \frac{12.8}{3600} + D_{(east)} \times \frac{206}{3600}}{\cos \lambda}$   
 $\phi_{(vert)} = ( )$  \_\_\_\_\_ degrees

Table I

| Location | Latitude $\lambda$ | Cos $\lambda$ |
|----------|--------------------|---------------|
| NAA      | 33.921             | 0.82985       |
| MILA     | 28.516             | 0.87868       |
| MSC      | 29.556             | 0.86993       |

6.2.18.26.3 Perform the following calculations using the recorded data from 6.2.18.25 and 6.2.18.26.2.

- a. Z Gyro azimuth error 3 hrs (corrected) = line 3 -  $\phi_{(vert)}$   
Z Gyro azimuth error 3 hrs (corrected) = \_\_\_\_\_ corrected  
Z Gyro azimuth error (corrected) shall be 0.00 $\pm$ 0.573 degrees.
- b. X Gyro elevation error (3 hr) = line 1 \_\_\_\_\_  
X Gyro elevation error (3 hr) = \_\_\_\_\_ degrees
- c. Y Gyro elevation error (3 hr) = line 2 \_\_\_\_\_  
Y Gyro elevation error (3 hr) = \_\_\_\_\_ degrees  
The X and Y Gyro elevation errors shall be 0.00 $\pm$ 0.045 degrees.

6.2.19 CMC Voltage Margin Test

6.2.19.1 Verify that the G&N IMU HTR MNA and MNB breakers are engaged, computer MNA and MNB breakers are engaged, IMU MNA and MNB breakers are not engaged, and the G&N Power-IMU switch on the LEB Lighting Control Panel is in the OFF position. On K-148, enter VERB 36 ENTR.

6.2.19.2 On the PBA Adapter Module set the INHIBIT VOLTAGE FAIL switch to ON.

**CAUTION:** During the performance of this test the +4 VDC CMC Power Supply shall not be operated at less than +2.5 VDC or greater than 5.2 VDC (CG 1030). The +14 VDC CMC Power Supply shall not be operated at less than +8.5 VDC or greater than +17.0 VDC (CG 1020). Rotate the LEB LTS NUMERICS SEL to approximately center position. Decrease to absolute minimum

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6.2.19.2 discernable lighting.  
(cont)

NOTE: The flashing indication of the CMC Power Supplies on CRT may be disregarded for this test. The charts in Table I may be used to determine approximate values for the "XX.X" values of C-156 voltage dial settings corresponding to various power supply voltages.

6.2.19.2.1 Into R-153, insert 1100. Verify and execute.

6.2.19.3 Units R-154, insert 0001. Verify and execute.

6.2.19.4 Insert in C-156, -040001244 and execute. Verify on CRT that GV0116 is between -3.0 and -5.0 vdc.

6.2.19.5 Insert in C-156 -050001234 and execute. Verify on CRT that GV0106 is between -4.0 and -6.0 vdc.

6.2.19.6 Units R-154, insert 0111. Verify and execute.

6.2.19.7 Observe CG 1020, +14 VDC Power Supply, and CG 1030, +4 VDC Power Supply on CRT. Repeat 6.2.19.3 through 6.2.19.6 adjusting each C Start entry until CG 1020 is 12.1, +0.1, -0.0 vdc and CG 1030 is 2.40, +0.03, -0.00 vdc.

6.2.19.8 Initiate CMC Self Check by inserting the following in K-149.

- a. ERROR RESET
- b. VERB 21, NOUN 27, ENTER
- c. 77777, ENTER

Wait 200 seconds.

6.2.19.9 Insure that the DSKY RESTART lamp does not light, and that

- a. VERB 05 NOUN 31
  - b. R1 = 01102
- does not appear on DSKY.

6.2.19.9.1 Into R-154, insert 0101. Verify and execute.

6.2.19.10 Set INHIBIT VOLTAGE FAIL switch to OFF on PSAAM.  
Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. If RESTART lamp does not light, repeat 6.2.19.3. Verify CMC Warning master alarms are lighted.

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- 6.2.19.11 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- ERROR RESET
  - VERB 21, NOUN 27, ENTER
  - 77777, ENTER
- 6.2.19.12 Units R-154, insert 0001. Verify and execute.
- 6.2.19.13 Insert in C-156 +108001244 and execute. Verify on CRT that GV0116 is between +0.8 and +11.8 vdc.
- 6.2.19.14 Units R-154, insert 0111. Verify and execute.
- 6.2.19.15 Observe CG 1020, +14 VDC Power Supply on CRT. Repeat 6.2.19.12 through 6.2.19.14 adjusting the C Start entry until CG 1020 is 16.4, +0.1, -0.9 vdc.
- 6.2.19.16 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- VERB 05, NOUN 31
  - R1 = 01102
- does not appear on DSKY.
- 6.2.19.16.1 Into R-154, insert 0011. Verify and execute.
- 6.2.19.17 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted. ~~Verify that the DSKY RESTART lamp is lighted and the DSKY RESTART lamp is lighted.~~
- 6.2.19.18 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- ERROR RESET
  - VERB 21, NOUN 27, ENTER
  - 77777, ENTER
- 6.2.19.19 Units R-154, insert 0001. Verify and execute.
- 6.2.19.20 Insert in C-156, +092001234 and execute. Verify on CRT that GV0106 is between +8.2 and +19.2 vdc.
- 6.2.19.21 Units R-154, insert 0111. Verify and execute.
- 6.2.19.22 Observe CG 1030, +4 VDC Power Supply on CRT. Repeat 6.2.19.19 through 6.2.19.21 adjusting the C Start entry until CG 1030 is 4.00, +0.08 -0.08 vdc.
- 6.2.19.23 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- VERB 05, NOUN 31
  - R1=01102
- does not appear on DSKY.
- 6.2.19.23.1 Into R-154, insert 0101. Verify and execute.



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- 6.2.19.24 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning-master alarms are lighted. If the CG 1020 is displaying CG 1020 and CG 1030 at PSAAM interface instead of CRT.
- 6.2.19.25 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- ERROR RESET
  - VERB 21, NOUN 27, ENTER
  - 77777, ENTER.
- 6.2.19.26 Units R-154, insert 0001. Verify and execute.
- 6.2.19.27 Insert in C-156, -040001244 and execute. Verify on CRT that GV0116 is between -3.0 and -5.0 vdc.
- 6.2.19.28 Units R-154, insert 0111. Verify and execute.
- 6.2.19.29 Observe CG 1020, +14 VDC Power Supply on CRT. Repeat 6.2.19.26 through 6.2.19.28 adjusting the C Start entry until CG 1020 is 12.1, +0.1, -0.0 vdc.
- 6.2.19.30 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- VERB 06, NOUN 31
  - R1 = 01102
- does not appear on DSKY.
- 6.2.19.30.1 Into R-154, insert 0011. Verify and execute.
- 6.2.19.31 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning-master alarms are lighted. If the CG 1020 is displaying CG 1020 and CG 1030 at PSAAM interface instead of CRT.
- 6.2.19.32 Units R-154, insert 0000. Verify and execute.
- 6.2.19.33 Terminate CMC Self-Check by inserting into K-148:
- ERROR RESET
  - VERB 21, NOUN 27, ENTER
  - 00000, ENTER
- 6.2.19.34 Ensure that CG 1020, +14 VDC Power Supply indication is +14.0,  $\pm 0.4$ , and that CG 1030, +4 VDC Power Supply indication is +4.00 $\pm 0.20$  VDC on CRT.

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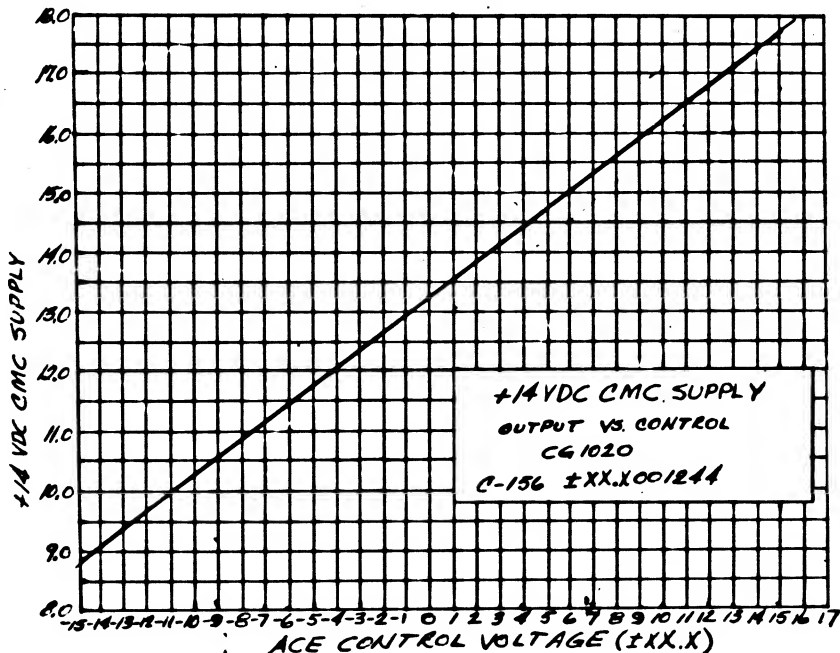
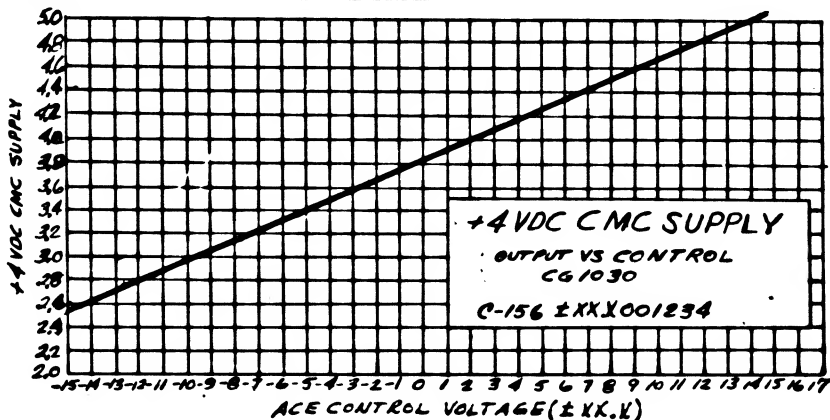


TABLE I

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**6.2.20 Spacecraft Control and Displays Test**

Conduct this test in accordance with the test plan for 6.2.20 and

**6.2.20.1 Perform Master Initialization before proceeding.** If a suspension occurs, resume the test after the suspension.**6.2.20.2 FDAI Attitude Error****6.2.20.2.1 Insert in K148**

- a. V 57 ENTER
- b. 00013 ENTER

**6.2.20.2.2 Observe on CRT**

- a. V 96 NO1 Flashing
- b. PROG 07
- c. NO ATT ON
- d. R1, R2, and R3 Approx. 00000

**6.2.20.2.3 Insert in K148**

- a. VERB 33, ENTER

**6.2.20.2.4 Observe on CRT**

- a. V 96 NO1 Flashing
- b. R1 +00385
- c. R2 -00385
- d. R3 +00385
- e. NO ATT OFF

**6.2.20.2.5 Record CRT indications**

- a. CG 2279 ROLL ATT ERROR - CDU DAC OUT  $\pm 0.06 \pm 0.06$  VERMS
- b. CG 2219 PITCH ATT ERROR - CDU DAC OUT  $\pm 0.06 \pm 0.06$  VERMS
- c. CG 2249 YAW ATT ERROR - CDU DAC OUT  $\pm 0.06 \pm 0.06$  VERMS

**6.2.20.2.6 Insert in K148**

- a. VERB 33, ENTER

**6.2.20.2.7 Observe on CRT**

- a. V 96 NO1 Flashing
- b. R1 +00384
- c. R2 -00384
- d. R3 +00384

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## 6.2.20.2.8 Record CRT indications

|            |                               |                 |     |
|------------|-------------------------------|-----------------|-----|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT  | +8.00±0.06 VRMS | ccs |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | -8.00±0.06 VRMS | ccs |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT   | +8.00±0.06 VRMS | ccs |

## 6.2.20.2.9 Insert in KI48

a. VERB 33, ENTER

## 6.2.20.2.10 Observe on CRT

|         |     |          |
|---------|-----|----------|
| a. V 00 | NO1 | Flashing |
| b. R1   |     | +00160   |
| c. R2   |     | -00160   |
| d. R3   |     | +00160   |

## 6.2.20.2.11 Record CRT indications

|            |                               |                 |     |
|------------|-------------------------------|-----------------|-----|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT  | +8.11±0.27 VRMS | ccs |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +8.11±0.27 VRMS | ccs |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT   | +8.11±0.27 VRMS | ccs |

## 6.2.20.2.12 Insert in KI48

a. VERB 33, ENTER

## 6.2.20.2.13 Observe on CRT

|         |     |          |
|---------|-----|----------|
| a. V 00 | NO1 | Flashing |
| b. R1   |     | +00135   |
| c. R2   |     | -00135   |
| d. R3   |     | +00135   |

## 6.2.20.2.14 Record CRT indications

|            |                               |                 |     |
|------------|-------------------------------|-----------------|-----|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT  | +1.78±0.23 VRMS | ccs |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | -1.78±0.23 VRMS | ccs |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT   | +1.78±0.23 VRMS | ccs |

## 6.2.20.2.15 Insert in KI48

a. VERB 33, ENTER

## 6.2.20.2.16 Observe on CRT

|         |     |          |
|---------|-----|----------|
| a. V 00 | NO1 | Flashing |
| b. R1   |     | +00090   |
| c. R2   |     | -00090   |
| d. R3   |     | +00090   |

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6.2.20.2.17 Record CRT indications

|            |                               |                     |
|------------|-------------------------------|---------------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT  | +1.88±0.18 VERMS-es |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | -1.29±0.18 VERMS-es |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT   | +1.16±0.18 VERMS-es |

6.2.20.2.18 Insert in K148

a. VERB 33, ENTER

6.2.20.2.19 Observe on CRT

|         |     |          |
|---------|-----|----------|
| a. V 06 | NO1 | Flashing |
| b. R1   |     | +00000   |
| c. R2   |     | +00000   |
| d. R3   |     | -00090   |

6.2.20.2.20 Record CRT indications

|            |                               |                     |
|------------|-------------------------------|---------------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT  | 0.00±0.05 VERMS-es  |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | 0.00±0.05 VERMS-es  |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT   | -1.19±0.18 VERMS-es |

6.2.20.2.21 Insert in K148

a. VERB 33, ENTER

6.2.20.2.22 Observe on CRT

|         |     |          |
|---------|-----|----------|
| a. V 06 | NO1 | Flashing |
| b. R1   |     | -00090   |
| c. R2   |     | +00090   |
| d. R3   |     | -00135   |

6.2.20.2.23 Record CRT indications

|            |                               |                     |
|------------|-------------------------------|---------------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT  | -1.19±0.18 VERMS-es |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +1.19±0.18 VERMS-es |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT   | -1.78±0.23 VERMS-es |

6.2.20.2.24 Insert in K148

a. VERB 33, ENTER

6.2.20.2.25 Observe on CRT

|         |     |          |
|---------|-----|----------|
| a. V 06 | NO1 | Flashing |
| b. R1   |     | -00135   |
| c. R2   |     | +00135   |
| d. R3   |     | -00160   |

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6.2.20.2.26 Record CRT indications

|            |                               |                 |
|------------|-------------------------------|-----------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT  | -3.38±0.23 VRMS |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +1.78±0.23 VRMS |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT   | +2.11±0.27 VRMS |

6.2.20.2.27 Insert in K148

a. VERB 33, ENTER

6.2.20.2.28 Observe on CRT

|         |     |          |
|---------|-----|----------|
| a. V 06 | NO1 | Flashing |
| b. R1   |     | -00160   |
| c. R2   |     | +00160   |
| d. R3   |     | -00384   |

6.2.20.2.29 Record CRT indications

|            |                               |                 |
|------------|-------------------------------|-----------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT  | -6.11±0.27 VRMS |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +3.11±0.27 VRMS |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT   | -5.04±0.04 VRMS |

6.2.20.2.30 Insert in K148

a. VERB 33, ENTER

6.2.20.2.31 Observe on CRT

|         |     |          |
|---------|-----|----------|
| a. V 06 | NO1 | Flashing |
| b. R1   |     | -00384   |
| c. R2   |     | +00384   |
| d. R3   |     | -00385   |

6.2.20.2.32 Record CRT indications

|            |                               |                 |
|------------|-------------------------------|-----------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT  | -5.04±0.04 VRMS |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +5.04±0.04 VRMS |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT   | +5.04±0.04 VRMS |

6.2.20.2.33 Insert in K148

a. VERB 33, ENTER

6.2.20.2.34 Observe on CRT

|         |     |          |
|---------|-----|----------|
| a. V 06 | NO1 | Flashing |
| b. R1   |     | -00385   |
| c. R2   |     | +00385   |
| d. R3   |     | +00000   |

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6.2.20.2.35 Record CRT indications

|            |                               |                 |     |
|------------|-------------------------------|-----------------|-----|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT  | -5.00±0.00 VRMS | 100 |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +5.00±0.00 VRMS | 100 |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT   | 0.00±0.00 VRMS  | 100 |

6.2.20.2.36 Insert in K148

|          |     |       |
|----------|-----|-------|
| a. V 21  | NO1 | ENTER |
| b. 02545 |     | ENTER |
| c. 03437 |     | ENTER |
| d. V 33  |     | ENTER |

6.2.20.2.37 Observe on CRT

|           |     |                      |
|-----------|-----|----------------------|
| a. V 99   | MO2 | Flashing             |
| b. NO ATT |     | ON                   |
| c. R1     |     | +00000 approximately |
| d. R2     |     | +00000 approximately |
| e. R3     |     | +00000 approximately |

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6.2.20.3 TVC Test

6.2.20.3.1 The G/W Autopilot Control and SPS Ready discretes shall be applied to the G/W interface.

6.2.20.3.2 Set the OPTICS MODE selector on the Indicator Control panel to MAN. Set the OPTICS ZERO switch to OFF.

6.2.20.3.3 Insert in K148

a. VERB 33, ENTER

6.2.20.3.4 Observe on CRT

|         |      |          |
|---------|------|----------|
| a. V 01 | N 10 | Flashing |
| b. R1   |      | X7373    |
| c. R3   |      | 00030    |

6.2.20.3.5 Insert in K148

a. V 33 ENTER

6.2.20.3.6 Observe on CRT

|         |         |          |
|---------|---------|----------|
| a. V 01 | NOUW 10 | Flashing |
| b. R1   |         | 37777    |
| c. R3   |         | 00031    |

6.2.20.3.7 Insert in K148

a. V 33 ENTER

6.2.20.3.8 Observe on CRT

|         |      |          |
|---------|------|----------|
| a. V 06 | N 02 | Flashing |
| b. R1   |      | +00385   |
| c. R2   |      | -00385   |
| d. R3   |      | +00003   |

6.2.20.3.9 Record CRT indications

|            |                         |                        |
|------------|-------------------------|------------------------|
| a. CG 3722 | TRUNNION CDU DAC OUTPUT | +16.35+18.12+1.00 VRMS |
| b. CG 3721 | SHAFT CDU DAC OUTPUT    | -16.35-18.12+1.00 VRMS |

6.2.20.3.10 Insert in K148

a. VERB 33, ENTER



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6.2.20.3.11 Observe on CRT

|           |      |          |
|-----------|------|----------|
| a. V 06   | N 03 | Flashing |
| b. R1     |      | +00384   |
| c. R2     |      | -00384   |
| d. R3     |      | +00003   |
| e. NO ATT |      | OFF.     |

6.2.20.3.12 Record CRT indications

|            |                         |                  |
|------------|-------------------------|------------------|
| a. CG 3722 | TRUNNION CDU DAC OUTPUT | +10.12±1.00 VRMS |
| b. CG 3721 | SHAFT CDU DAC OUTPUT    | -10.12±1.00 VRMS |

6.2.20.3.13 Insert in K148

a. VERB 33, ENTER

6.2.20.3.14 Observe on CRT

|         |      |          |
|---------|------|----------|
| a. V 06 | N 03 | Flashing |
| b. R1   |      | +00160   |
| c. R2   |      | -00160   |
| d. R3   |      | +00003   |

6.2.20.3.15 Record CRT indications

|            |                         |                 |
|------------|-------------------------|-----------------|
| a. CG 3722 | TRUNNION CDU DAC OUTPUT | +4.23±0.42 VRMS |
| b. CG 3721 | SHAFT CDU DAC OUTPUT    | -4.23±0.42 VRMS |

6.2.20.3.16 Insert in K148

a. VERB 33, ENTER

6.2.20.3.17 Observe on CRT

|         |      |          |
|---------|------|----------|
| a. V 06 | N 03 | Flashing |
| b. R1   |      | +00135   |
| c. R2   |      | -00135   |
| d. R3   |      | +00003   |

6.2.20.3.18 Record CRT indications

|            |                         |                 |
|------------|-------------------------|-----------------|
| a. CG 3722 | TRUNNION CDU DAC OUTPUT | +2.34±0.36 VRMS |
| b. CG 3721 | SHAFT CDU DAC OUTPUT    | -2.34±0.36 VRMS |

6.2.20.3.19 Insert in K148

a. VERB 33, ENTER

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6.2.20.3.20 Observe on CRT

|         |      |          |
|---------|------|----------|
| a. V 06 | N 03 | Flashing |
| b. R1   |      | +00090   |
| c. R2   |      | -00090   |
| d. R3   |      | +00003   |

6.2.20.3.21 Record CRT indications

|            |                         |                 |
|------------|-------------------------|-----------------|
| a. CG 3722 | TRUNNION CDU DAC OUTPUT | +2.38±0.24 VRMS |
| b. CG 3721 | SHAFT CDU DAC OUTPUT    | -2.38±0.24 VRMS |

6.2.20.3.22 Set the OPTICS SPEED Switch on the Indicator Control Panel to RL, 1 panel to HI.

6.2.20.3.23 Insert in KL48

a. VERB 33, ENTER

6.2.20.3.24 Observe on CRT

|         |      |          |
|---------|------|----------|
| a. V 06 | N 03 | Flashing |
| b. R1   |      | +00000   |
| c. R2   |      | +00000   |
| d. R3   |      | +00003   |

6.2.20.3.25 While holding the Optics Hand Controller up and left (45°) no longer than 10 seconds, record CRT indications.

|            |                         |                |
|------------|-------------------------|----------------|
| a. CG 3722 | TRUNNION CDU DAC OUTPUT | 0.80±0.13 VRMS |
| b. CG 3721 | SHAFT CDU DAC OUTPUT    | 0.00±0.13 VRMS |

6.2.20.3.26 Insert in KL48

a. VERB 33, ENTER

6.2.20.3.27 Observe on CRT

|         |      |          |
|---------|------|----------|
| a. V 06 | N 03 | Flashing |
| b. R1   |      | -00090   |
| c. R2   |      | +00090   |
| d. R3   |      | +00003   |

6.2.20.3.28 Record CRT indications

|            |                         |                 |
|------------|-------------------------|-----------------|
| a. CG 3722 | TRUNNION CDU DAC OUTPUT | -2.38±0.24 VRMS |
| b. CG 3721 | SHAFT CDU DAC OUTPUT    | +2.38±0.24 VRMS |

- 6.2.20.3.29 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the Indicator Control Panel to ZERO for 30 seconds, then return to OFF.
- 6.2.20.3.30 Insert in KI48
- a. VERB 33, ENTER
- 6.2.20.3.31 Observe on CRT
- a. V 06 N 02 Flashing  
b. R1 -00135  
c. R2 +00135  
d. R3 +00003
- 6.2.20.3.32 Record CRT indications
- a. CG 3722 TRUNNION CDU DAC OUTPUT -3.56±0.36 VRMS  
b. CG 3721 SHAFT CDU DAC OUTPUT +3.56±0.36 VRMS
- 6.2.20.3.33 Insert in KI48
- a. VERB 33, ENTER
- 6.2.20.3.34 Observe on CRT
- a. V 06 N 02 Flashing  
b. R1 -00160  
c. R2 +00160  
d. R3 +00003
- 6.2.20.3.35 Record CRT indications
- a. CG 3722 TRUNNION CDU DAC OUTPUT -4.22±0.42 VRMS  
b. CG 3731 SHAFT CDU DAC OUTPUT +4.22±0.42 VRMS
- 6.2.20.3.36 Insert in KI48
- a. VERB 33, ENTER
- 6.2.20.3.37 Observe on CRT
- a. V 06 N 02 Flashing  
b. R1 -00384  
c. R2 +00384  
d. R3 +00003

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6.2.20.3.38 Record CRT indications

- a. CG 3722 TRUNNION CDU DAC OUTPUT -10.12±1.00 VRMS
- b. CG 3721 SHAFT CDU DAC OUTPUT +10.12±1.00 VRMS

6.2.20.3.39 Insert in K148

- a. VERB 33, ENTER

6.2.20.3.40 Observe on CRT

- a. V 00 N 02 Flashing
- b. R1 -00385
- c. R2 +00385
- d. R3 +00003

6.2.20.3.41 Record CRT indications

- a. CG 3722 TRUNNION CDU DAC OUTPUT -10.12±1.00 VRMS
- b. CG 3721 SHAFT CDU DAC OUTPUT +10.12±1.00 VRMS

6.2.20.3.42 Insert in K148

- a. V 34 ENTER
- b. V 40 N 20 ENTER
- c. V 41 N 20 ENTER
- d. +00000 ENTER
- e. +00000 ENTER
- f. +00000 ENTER

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APPENDIX I

| Signal  | Link | Nomenclature                    | G&N Test Requirement                         | PSAAM and/or SCA Uncertainty % of Full Scale |
|---------|------|---------------------------------|----------------------------------------------|----------------------------------------------|
| CG 1020 | 1    | +14 VDC CMC SUPPLY              | +14.0 ± 0.4 VDC                              | 0%                                           |
| CG 1030 | 1    | +4 VDC CMC SUPPLY               | +4.00 ± 0.2 VDC                              | 0%                                           |
| CG 1040 | 2    | +120 VDC PIPA SUPPLY            | +120 ± 6.0 VDC                               | 1%                                           |
| CG 1051 | 1    | +20 VDC PIPA SUPPLY             | +20.0 ± 1.2 VDC                              | 0%                                           |
| CG 1052 | 1    | -20 VDC PIPA SUPPLY             | -20 ± 2 VDC                                  | 0%                                           |
| CG 1070 | 1    | +4 VDC CDU SUPPLY               | +4.0 ± 0.2 VDC                               | 0%                                           |
| CG 1100 | 1    | -28 VDC SUPPLY                  | -27.5 ± 6.0 VDC                              | 0%                                           |
| CG 1110 | 2    | 2.5 VDC TM BIAS                 | +2.50±0.04 VDC                               | 0%                                           |
| CG 1201 | 2    | IMU 28V .8KC 1% 0° RMS          | 28.00 ± 0.56 VRMS                            | 1%                                           |
| CG 1202 | 1    | IMU 28V .8 KC 5% - 90° RMS      | 28.0 ± 1.4 VRMS                              | 0.33%                                        |
| CG 1203 | 1    | IMU 28V .8KC 0° RMS             | 28.0 ± 2.1 VRMS                              | 0.33%                                        |
| CG 1207 | 1    | PH DIFF IMU 5% 0°, -90°         | -90±10°                                      | 2.3%                                         |
| CG 1211 | 1    | OPTX 28V .8KC 1% 0° RMS         | 28.00 ± 0.56 VRMS                            | 0.33%                                        |
| CG 1212 | 1    | OPTX 28V .8KC 5% -90° RMS       | 28.00 ± 1.46 VRMS                            | 0.33%                                        |
| CG 1220 | 1    | PH DIFF OPTX 1% IMU 1%          | 0° ± 10°                                     | 2.3%                                         |
| CG 1331 | 2    | 3.2 KC 28V SUPPLY               | 28.6 ± 0.56 VRMS                             | 1%                                           |
| CG 1336 | 1    | PH DIFF 3.2 KC 28V/CMC SYNC 1   | 0° ± 10°                                     | 2.3%                                         |
| CG 1500 | 1    | +28 VDC IMU OPERATE BUS         | 28.8 ± 3VDC                                  | 0%                                           |
| CG 1510 | 1    | +28 VDC IMU STANDBY BUS         | 28.8 ± 3 VDC                                 | 0%                                           |
| CG 1520 | 1    | +28 VDC CMC OPERATE BUS         | 28.8 ± 3 VDC                                 | 0%                                           |
| CG 1530 | 1    | +28 VDC OPTX OPERATE BUS        | 28.8 ± 3 VDC                                 | 0%                                           |
| CG 2001 | 2    | X PIPA SG O/P                   | 5 VRMS max                                   | 3%                                           |
| CG 2021 | 2    | Y PIPA SG O/P                   | 5 VRMS max                                   | 0.23%                                        |
| CG 2041 | 2    | Z PIPA SG O/P                   | 5 VRMS max                                   | 3%                                           |
| CG 2108 | 2    | IG SERVO ERROR QUAD             | 0.0 ± 1.2 VRMS                               | 2.5%                                         |
| CG 2112 | 2    | IG LX RESOLVER O/P SIN          | 18.38±1.84 VRMS @ 45°                        | 2.5%                                         |
| CG 2113 | 2    | IG LX RESOLVER O/P COS          | 18.38±1.84 VRMS @ 45°                        | 2.5%                                         |
| CG 2117 | 2    | IG SERVO ERROR IN PHASE         | 0.0 ± 60mv RMS @ null                        | 1.4%                                         |
| CG 2120 | 1    | IG TORQUE MOTOR CURRENT         | 0.125 amp max during Fine Alignment Torquing | 0%                                           |
| CG 2138 | 1    | MG SERVO ERROR QUAD             | 0.0 ± 1.2 VRMS                               | 2.5%                                         |
| CG 2142 | 2    | MG LX RESOLVER O/P SIN          | 18.38±1.84 VRMS @ 45°                        | 2.5%                                         |
| CG 2143 | 2    | MG LX RESOLVER O/P COS          | 18.38±1.84 VRMS @ 45°                        | 2.5%                                         |
| CG 2147 | 2    | MG SERVO ERROR IN PHASE         | 0.0 ± 60 mv rms @ null                       | 1.4%                                         |
| CG 2150 | 1    | MG TORQUE MOTOR CURRENT         | 0.125 amp max during Fine Align Torquing     | 0%                                           |
| CG 2168 | 1    | OG SERVO ERROR QUAD             | 0.0 ± 1.2 VRMS                               | 2.5%                                         |
| CG 2172 | 2    | OG LX RESOLVER O/P SIN          | 18.38±1.84 VRMS @ 45°                        | 2.5%                                         |
| CG 2173 | 2    | OG LX RESOLVER O/P COS          | 18.38±1.84 VRMS @ 45°                        | 2.5%                                         |
| CG 2177 | 2    | OG SERVO ERROR IN PHASE         | 0.0 ± 60mvRMS @ null                         | 1.4%                                         |
| CG 2180 | 1    | OG TORQUE MOTOR CURRENT         | 0.125 amp max during Fine Align Torquing     | 0%                                           |
| CG1042  | 1    | +120 VDC PIPA SUP NOISE RMS     | 1.5 VRMS MAX                                 | 0%                                           |
| CG1053  | 1    | +20 VDC PIPA SUP NOISE RMS      | 1.0 VRMS MAX                                 | 0%                                           |
| CG1071  | 1    | +4 VDC CDU SUP NOISE RMS        | 0.10 VRMS MAX                                | 0%                                           |
| CG1501  | 1    | +28V IMU OPERATE BUS NOISE RMS  | 1.0 VRMS MAX                                 | 0%                                           |
| CG1511  | 1    | +28V IMU STANDBY BUS NOISE RMS  | 1.0 VRMS MAX                                 | 0%                                           |
| CG1531  | 1    | +28V CMC OPERATE BUS NOISE RMS  | 2.0 VRMS MAX                                 | 0%                                           |
| CG1531  | 1    | +28V OPTX OPERATE BUS NOISE RMS | 2.0 VRMS MAX                                 | 0%                                           |

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| Signal  | Link | Nomenclature                      | GAN Test Requirement            | PSAAM and/or SCA Uncertainty % of Full Scale |
|---------|------|-----------------------------------|---------------------------------|----------------------------------------------|
| CG 2219 | 1    | PITCH ATT ERROR - CDU DAC O/P     | 5.06 ± 0.5 VRMS @ 17°           | 0.67%                                        |
| CG 2220 | 1    | IG CDU FINE ERROR                 | 0.0 ± 0.07VRMS @ null           | 0.29%                                        |
| CG 2221 | 1    | IG CDU COARSE ERROR               | 0.0 ± 0.68 VRMS @null           | 0.29%                                        |
| CG 2249 | 1    | YAW ATT ERROR-CDU DAC O/P         | 5.06 ± 0.5VRMS @ 17°            | 0.67%                                        |
| CG 2250 | 1    | MG CDU FINE ERROR                 | 0.0 ± 0.07VRMS @ null           | 0.29%                                        |
| CG 2251 | 1    | MG CDU COARSE ERROR               | 0.0 ± 0.68VRMS @ null           | 0.29%                                        |
| CG 2279 | 1    | ROLL ATT ERROR-CDU DAC O/P        | 5.06 ± 0.5VRMS @17°             | 0.67%                                        |
| CG 2280 | 1    | OG CDU FINE ERROR                 | 0.0 ± 0.07 VRMS 2 null          | 0.29%                                        |
| CG 2281 | 1    | OG CDU COARSE ERROR               | 0.0 ± 0.68 VRMS                 | 0.29%                                        |
| CG 2300 | 1    | PIPA TEMPERATURE                  | 130.5±1.5°F Operate Mode        | 2%                                           |
| CG 3011 | 2    | TRUNNION CDU FINE ERROR           | 0.0 ± 0.07VRMS @ null           | 0.29%                                        |
| CG 3021 | 2    | SHAFT CDU FINE ERROR              | 0.0 ± 0.07VRMS @ null           | 0.29%                                        |
| CG 3117 | 1    | SXT SHAFT SERVO ERROR IN PH       | 2 VRMS max                      | 1.1%                                         |
| CG 3118 | 1    | SXT TRUNNION SERVO ERROR IN PHASE | 2 VRMS max                      | 1.1%                                         |
| CG 3140 | 1    | SXT SHAFT TACH O/P                | 3.3 ± 1.3VRMS @ Hi Rate         | 1.1%                                         |
| CG 3145 | 1    | SXT SHAFT MIR CONTROL WINDING     | +0.50 to +4.00V RMS Mod Rate    | 1.1%                                         |
| CG 3150 | 2    | SXT TRUNNION TACH O/P             | 3.3 ± 1.3VRMS @ Hi Rate         | 1.1%                                         |
| CG 3155 | 1    | SXT TRUNNION MIR CONTROL WINDING  | +0.50 to +2.00 VRMS<br>Mod Rate | 1.1%                                         |
| CG 3160 | 1    | SCT SHAFT TACH O/P                | 3.3 ± 1.3 VRMS @ Hi Rate        | 1.1%                                         |
| CG 3170 | 1    | SCT TRUNNION TACH O/P             | 0.85 ± 0.35 VRMS @Hi Rate       | 1.1%                                         |
| CG 3721 | 1    | SHAFT CDU DAC O/P                 | 10.12±1.00 VRMS @17°            | 1%                                           |
| CG 3722 | 2    | TRUNNION CDU DAC O/P              | 10.12±1.00 VRMS @ 17°           | 1%                                           |
| CG 4300 | 2    | CMC TEMP                          | 87.5±42.5°F                     | 0.23%                                        |
| CG 6020 | 1    | PIPA CAL MODULE TEMP              | 72.5±27.5°F                     | 0.23%                                        |
| CG 6021 | 1    | IMU 800 cps 5% TEMP (PSA)         | 90±30°F                         | 0%                                           |
| CG 2301 | 1    | IRIG TEMPERATURE                  | 135 ± 2.5°F in Operate          | 2%                                           |
| CG 1081 | 1    | +14V CMC SUPPLY NOISE RMS         | 0.2 VRMS max                    | 0%                                           |
| CG 1081 | 1    | +4 CMC SUPPLY NOISE RMS           | 0.2 VRMS max                    | 0%                                           |

THE DATA FOR THIS SPECIFICATION IS BASED ON THE ASSUMPTION THAT THE GAN AND SCA OUTPUTS ARE THE SOURCE OF THE SIGNALS FOR THE PSAAM AND SCA OUTPUTS. THE DATA FOR THE PSAAM AND SCA OUTPUTS IS BASED ON THE ASSUMPTION THAT THE GAN AND SCA OUTPUTS ARE THE SOURCE OF THE SIGNALS FOR THE PSAAM AND SCA OUTPUTS.

PSAAM OUTPUT is the source of Link 1 signals  
SCA OUTPUT is the source of Link 2 signals.

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### ADDENDUM I

**SCOPE:** The following changes are required to make ND1002325 applicable as G&N System technical support documentation for CSM 101.

**Addition 1.** Add paragraph 6.1.1.7 as follows:

**6.1.1.7** Data from the on-board tape recorder shall be made available and the following signals verified:

- a. IG TORQUE MOTOR CURRENT (CG 2120) shall be less than 0.125 amp max.
- b. OG TORQUE MOTOR CURRENT (CG 2180) shall be less than 0.125 amp max.
- c. MG TORQUE MOTOR CURRENT (CG 2150) shall be less than 0.125 amp max.

**Addition 2.** Paragraph 6.2.1.5.6, change the last sentence to read as follows:

On the Event Recorder verify that the IMU HTR Current switch discrete (CG 2302 Link 2) is on and that the IMU Blower Current discrete (CG 2303 Link 2) is OFF over the last 2 hour period (occasionally discretizes may cycle).

**Addition 3.** Add paragraph 6.2.4.6.1 as follows:

**6.2.4.6.1** On the analog recorder verify that (CG 1211 Link 2, OPTICS 28V 800 cps 1% 0 deg) RMS voltage is  $28.0 \pm 0.06$  VAC.

**Addition 4.** Add Paragraph 6.2.20.2.5.1 and 6.2.20.2.32.1 as follows:

**6.2.20.2.5.1** Verify on the analog recorder the following signals:

- a. CG 2279 Link 2 ROLL ATT ERROR - CDU DAC OUT  $+5.06 \pm 0.66$  VRMS
- b. CM 2219 Link 2 PITCH ATT ERROR - CDU DAC OUT  $-5.06 \pm 0.66$  VRMS
- c. CG 2249 Link 2 YAW ATT ERROR - CDU DAC OUT  $+5.06 \pm 0.66$  VRMS

**6.2.20.2.32.1** Verify on the analog recorder the following signals:

- a. CG 2279 Link 2 ROLL ATT ERROR - CDU DAC OUT  $-5.06 \pm 0.66$  VRMS
- b. CG 2219 Link 2 PITCH ATT ERROR - CDU DAC OUT  $+5.06 \pm 0.66$  VRMS
- c. CG 2249 Link 2 YAW ATT ERROR - CDU DAC OUT  $-5.06 \pm 0.66$  VRMS

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**Addition 5.** Paragraph 6.1.2.1., add new Paragraph 6.1.2.1.5 as follows:

**6.1.2.1.5** Data from the on-board tape recorder shall be made available and the following signals verified.

- a. VIB NB ROLL (CG 6001)
- b. VIB NB PITCH (CG 6002)
- c. VIB NB YAW (CG 6003)

**Addition 6.** Replace Paragraph 6.2.3.1.13 with the following:

**6.2.3.1.13** 30 minutes after switching from Standby mode to the Operate mode record the IRIG temperature. The recorded IRIG temperature shall be within 0.5 deg F. of the Operate stabilized IRIG temperature determined below.

Add the following sentence to Paragraph 6.2.3.1.14:

Record the Operate mode stabilized IRIG temperature. The Operate mode stabilized IRIG temperature shall be 135±2.5° F.

Paragraph 6.2.5.2.16, add the following to Table VI:

14 CG 2301 IRIG TEMPERATURE

**Addition 7.** Paragraph 6.1.1.6, add item "f" as follows:

- f. The TRACKER switch on G&N Indicator Control Panel shall be set to OFF.

**Addition 8.** Replace Paragraph 6.2.3.1.2 with the following:

**6.2.3.1.2** Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to EXT). Switch and selectors on the G&N Indicator Control Panel shall be set as follows.

- a. CONTROLLER COUPLING to DIRECT
- a. OPTICS MODE to ZERO MED
- b. CONTROLLER COUPLING to DIRECT EXT
- c. CONTROLLER SPEED to MED (at brightness position)
- d. TELESCOPE TRUNNION to SLAVE to EXT
- e. RETICLE BRIGHTNESS to minimum brightness position

**Addition 9.** Replace Paragraph 6.2.5.1.2 with the following:

**6.2.5.1.2** Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to EXT). Set the



following switches on the G&N Indicator Control Panel to the positions designated.

- a. OPTICS MODE to ZERO
- b. CONTROLLER MODE to DIRECT
- c. CONTROLLER SPEED to LO
- d. TELESCOPE TRUNNION to SLAVE to SXT
- e. RETICLE BRIGHTNESS to minimum brightness position

**Addition 10.**

Replace Paragraph 6.2.5.2.1 with the following:

**6.2.5.2.1**

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set or verify the following G&N Indicator Control Panel switches to the position indicated.

- a. CONDITION LAMPS to ON
- b. OPTICS MODE to ZERO
- c. CONTROLLER COUPLING to DIRECT
- d. CONTROLLER SPEED to LO
- e. TELESCOPE TRUNNION to SLAVE to SXT
- f. RETICLE BRIGHTNESS to minimum brightness position

**Addition 11.**

Replace Paragraph 6.2.5.3.6 with the following:

**6.2.5.3.6**

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Insure that the following switches are set to the positions indicated:

- a. CONTROLLER COUPLING to DIRECT
- b. OPTICS MODE to ZERO
- c. TELESCOPE TRUNNION to SLAVE to SXT
- d. TRACKER to OFF
- e. CONTROLLER SPEED to LO
- f. CONDITION LAMPS to ON
- g. UP TELEMETRY to ACCEPT

**Addition 12.**

Replace Paragraph 6.2.9.23 with the following:

**6.2.9.23**

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to CMC.

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Addition 13. Replace Sections 6.2.10 through 6.2.13 with the following:

**6.2.10 Zero Optics Test**

**NOTE:** Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2 Turn On Procedure before proceeding.

**INITIALIZATION**

**6.2.10.1** Set the G/N POWER - OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

**6.2.10.2** Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.

- a. VERB 41, NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

**6.2.10.3** Insure that the following switches on the G&N Indicator Control Panel are set as follows:

- a. TELESCOPE TRUNNION to SLAVE to SXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to HI

**OPTICS ZERO MODE TEST**

**6.2.10.4** Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K-148. Press the ENTER pushbutton.

**6.2.10.5** Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following on R1 and R2 of the DSKY (Trunnion LOS Angle)

- a. R1 = +0.00° +0.03°, -0.03° (Shaft Angle)
- b. R2 = +0.000° +0.006°, -0.007° (Trunnion LOS Angle)

6.2.10.5.1 Enter the following

VERB 01 NOUN 10, ENTER  
00033, ENTER  
Verify R1 = XXX6X

6.2.10.5.2 Set the OPTICS MODE switch to CMC. Enter the following:

ENTER  
00033, ENTER  
Verify R1 = XXX5X

6.2.10.5.3 Set the OPTICS MODE switch to MAN. Press the KEY REL pushbutton on the DSKY.

OPTICS BACKUP MODE TEST

6.2.10.6 Insert the Inflight Tool (V36601405) into the Trunnion Tool input and engage drive mechanism (button out). Verify that the trunnion turns by viewing the movement through the SCT eyepiece while turning the tool until the TPAC reads +8 deg. Remove the tool from the trunnion tool input.

6.2.10.7 Insert the Inflight Tool (V36601405) into the Shaft Tool input and engage the drive mechanism (button out). Verify that the shaft turns by viewing the movement through the SCT eyepiece while turning the tool so that the shaft moves through an angle from 0° to +3 to -3 to 0 as indicated on the shaft TPAC. Disengage the shaft drive mechanism (button in) and remove the tool.

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6.2.10.8 *8* Insert the Inflight Tool (V36601405) into the Trunnion Tool input. Verify that the Trunnion Turns by viewing the movement through the SCT eye-piece while turning the tool so that the trunnion moves from +5° to -5° and back to zero as indicated on the Trunnion TPAC. Disengage the trunnion drive mechanism (button in) and remove the tool.

6.2.11 Optics Coordinate Transformation Control Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure before proceeding.

#### INITIALIZATION

6.2.11.1 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.11.2 Enter the following into the K-Start. Press the ENTER pushbutton after each entry:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.11.3 Verify and/or set the following switches on the G&N Indicator control panel to the position indicated.

- a. TELESCOPE TRUNNION to SLAVE to EXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to HI

6.2.11.4 Set up the analog recorders to monitor the following measurements.

- a. CG 3170 SCT Trunnion Tachometer Output

6.2.11.5 Enter the following into the K-Start to monitor the OPTICS CDU's.

VERB 16 NOUN 55, press ENTER

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- 6.2.11.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within  $\pm 5$  degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the G&N Panel to ZERO. Wait 15 seconds. Return the OPTICS MODE switch to MAN.
- RESOLVED MODE PHASING AND IMAGE RATE TEST
- 6.2.11.7 Using the Optics Control Stick, drive the Optics until  $R1 = +225.00$  and  $R2 = +10.000$  on the CRT and the DSKY's.
- 6.2.11.8 Set the CONTROLLER COUPLING switch on the G&N Panel to RSLV and CONTROLLER SPEED switch to MED.
- 6.2.11.9 Position the movable optics target such that it is centered on the SCT reticle pattern, then start the analog recorders at a chart speed of 10 mm/second.
- 6.2.11.10 Quickly displace the Optics Control Stick  $45 \pm 10$  degrees in the upper right hand quadrant while sighting on the optics target through the SCT eyepiece. The target shall appear to move in the upper right field of view of the SCT at  $45 \pm 10$  deg. When target leaves the SCT upper right field of view press MARK pushbutton and immediately record the shaft angle as displayed on R1 of the DSKY. The recorded shaft angle shall be  $+225 \pm 10.00$  degrees.
- 6.2.11.11 Stop the analog recorder and measure the elapsed time between the initial and the final signal null conditions for the Trunnion measurement. The elapsed time shall be  $+19$  to  $+32$  seconds.
- CSM AMPLIFIER SHAFT AND TRUNNION DRIVE TEST
- 6.2.11.12 Set the CONTROLLER COUPLING switch to DIRECT. Again using the Optics Control Stick, drive the optics until  $R1 = +225.00$  and  $R2 = +10.000$ . Set the CONTROLLER COUPLING switch to RSLV.
- 6.2.11.13 While sighting on the optical target through the SCT eyepiece, displace the Optics Control Stick fully to the right. Verify that the target image appears to move in a straight line horizontally to the right and release the Optics Control Stick when the target image reaches the edge of the SCT field of view.
- 6.2.11.14 Enter VERB 34 in the DSKY. Press the ENTER pushbutton.

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- 6.2.11.15 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the CONTROL-  
LER COUPLING switch on the G&N Panel to DIRECT. Set the OPTICS MODE switch to ZERO. After 15 seconds, return the switch to MAN.

NOTE: If optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.12 Optics Functional Test

Proceed with this test if 6.2.3 Operate Power On Test, or 6.2.5.2 Turn-on Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding.

NOTE: This test requires the use of the G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT SLOS before proceeding. Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.

6.2.12.1 Set/verify the G/N POWER OPTICS switch on the LEB Lighting Control Panel to OPTICS. Set TRACKER switch to OFF. Verify the following:

- +28 VDC OPTX OPERATE BUS (CG 1530) is 28.8±3 VDC. Record the indication on the CRT.
- CG 1211 OPTX 28V 800 cps 1% 0 ph not flashing on CRT.
- CG 1212 OPTX 800 cps 5% -90 ph not flashing on CRT.

6.2.12.2 Enter the following sequence into the K-Start.

- VERB 41, NOUN 20, ENTER
- +00000, ENTER
- +00000, ENTER
- +00000, ENTER

6.2.12.3 Insure that the optics control switches on the G&N Indicator Control Panel are set as follows:

- OPTICS MODE to MAN
- CONTROLLER SPEED to LO
- CONTROLLER COUPLING to DIRECT
- TELESCOPE TRUNNION to SLAVE to SXT

- 6.2.12.4 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees to zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN.
- 6.2.12.5 Resolution Checks
- 6.2.12.5.1 Sight through the SXT eyepiece. Using the Optic Control Stick, adjust the SXT to obtain the best reflected field of view of the 5-inch autocollimator reticle engraving at the center of the field of view.
- 6.2.12.5.2 Note that the autocollimator reticle contains a series of lines of different thickness and width. Each set of lines is marked with a number (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines. The SXT resolution shall be at least 10 arc-seconds at the center of the field of view.
- 6.2.12.5.3 Repeat 6.2.12.5.1 and 6.2.12.5.2 using the SCT and the SCT resolution chart. The SCT shall have a resolution of at least 3 arc-minutes at the center of the field of view.
- 6.2.12.6 Slave Telescope Mode Checks
- 6.2.12.6.1 Enter VERB 16 NOUN 55 into the K-Start, press the ENTER pushbutton.
- 6.2.12.6.2 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the Control Indicator Panel to ZERO. Wait 15 seconds.
- 6.2.12.6.3 Record the SCT Shaft and Trunnion angles as indicated by the TPAC and the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between the TPAC shaft angle and the Shaft CDU angle shall be  $\pm 0.11$  deg or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be  $\pm 0.22$  deg or less.

- 6.2.12.6.4 Place the OPTICS MODE switch to MAN. Using the Optics Control Stick drive the SXT Shaft and Trunnion CDU's until  $R1 = 035.00 \pm 0.10$  deg and  $R2 = +35.00 \pm 0.100$  deg, setting the CONTROLLER SPEED switch to LO as the angles are approached. Press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles as indicated by the TPAC. Record  $R1$  and  $R2$ . The difference between the TPAC Shaft angle and Shaft CDU angle shall be  $\pm 0.11$  deg or less. The difference between the TPAC Trunnion angle and Trunnion CDU angle shall be  $\pm 0.22$  deg or less.
- 6.2.12.6.5 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within  $\pm 5$  degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO.
- 6.2.12.6.6 Set the TELESCOPE TRUNNION switch to SLAVE to SXT position.
- 6.2.12.6.7 Remove the plug from the base of the SXT eyepiece and install the Adapter Assembly and Portable Light Assembly. Turn on the light.
- NOTE: If needed to reduce external light, place a photographer hood over the optics head and retroreflecting prism.
- 6.2.12.6.8 Sight through the SCT eyepiece and provide direction to personnel outside spacecraft for positioning the Retroreflecting Prism, Model No. A23-200, to span between the SXT LLOS and SCT LOS such that the illumination from the back-light filament is clearly visible at the center of the field of view. Prism must be held in this alignment position until completion of step 6.2.12.6.11.
- 6.2.12.6.9 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Note the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement, expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. For instance, the outer ends of the SXT reticle lines are 6% from center. Displacement shall be less than 50% (bar must be closer to center than to edge of field of view).
- 6.2.12.6.10 Set the TELESCOPE TRUNNION switch to 6° position.
- 6.2.12.6.11 Again direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in Step 6.2.12.6.9. Place the OPTICS MODE switch to MAN and observe the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement, expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. Displacement shall be less than 50%.
- 6.2.12.6.12 Remove the Retroreflecting Prism.



- 6.2.12.6.13 Replace the Portable Light in the adapter on the EXT eyepiece.
- 6.2.12.6.14 While sighting into the SCT eyepiece, set the TELESCOPE TRUNNION switch to 25° and observe that the resolution pattern mounted outside the spacecraft appears to move downward from the center of the field of view to the zero reticle marking that is 25° below the center of the field of view.
- 6.2.12.6.15 Record the TPAC Trunnion Angle. It shall be  $25.00 \pm 0.22$  deg.
- 6.2.12.6.16 Set the TELESCOPE TRUNNION switch to SLAVE to EXT.
- 6.2.12.7 EXT Parallelism Tests
- 6.2.12.7.1 Using the Optics Control Stick drive the EXT StLOS Trunnion to  $+15.000^\circ \pm 2^\circ$  as indicated in R2 of the DSKY. Maintain a Shaft CDU angle of  $000.00 \pm 0.10$  degrees as indicated by R1 of the DSKY.
- 6.2.12.7.2 Sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to superimpose the EXT LLOS horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.
- 6.2.12.7.3 Repeat 6.2.12.7.2 twice. Calculate and record the average of the three autocollimator readings.
- 6.2.12.7.4 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the EXT Trunnion to within  $\pm 5$  degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to EXT). Set the OPTICS MODE switch to ZERO.
- 6.2.12.7.5 Again sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to bring the EXT StLOS horizontal reticle and autocollimator horizontal filar images to coincide. Record the autocollimator reading.
- 6.2.12.7.6 Repeat 6.2.12.7.5 twice. Calculate and record the average of the three autocollimator readings. The average value obtained here shall not differ from that obtained in 6.2.12.7.3 by more than 10 arc-seconds.
- 6.2.12.7.7 Set the OPTICS MODE switch to MAN. Using the Optics Control Stick drive the EXT Trunnion angle to  $85.00 \pm 5$  degrees as indicated on R2 of the DSKY. Set the CONTROLLER SPEED switch to LO and drive the EXT Trunnion to  $+90.000$  degrees  $\pm 0.100$  degree as indicated on R2 of the DSKY. Insure that the EXT Shaft angle remains at  $000.00 \pm 0.10$  degree as indicated by R1 on the DSKY.
- 6.2.12.7.8 Sight through the EXT. Two reticle patterns shall be visible. Use the Optics Control Stick to adjust the EXT Trunnion angle until the two horizontal reticle lines are coincident. Record the Trunnion CDU angle displayed in R2. The Trunnion CDU angle shall be  $90.000 \pm 0.10$  degrees.
- 6.2.12.7.9 Remove the Portable Light Assembly and Adapter Assembly from the base of the EXT eyepiece. Replace the EXT eyepiece plug.

**NOTE:** If optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

- 6.2.12.8 Shaft and Trunnion Positional Accuracy Checks
- 6.2.12.8.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds, return the selector to Manual.
- 6.2.12.8.2 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.3 Sight through the SXT. Using the control stick align the SXT SLOS with optical Target No. 1 on the G&N Installation Fixture Model A23-097. Set the CONTROLLER SPEED switch to LO as the target is approached. When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.
- 6.2.12.8.4 Sight through the SXT. Using the control stick align the SXT SLOS with Optical Target No. 2 on A23-097. Set the CONTROLLER SPEED switch to LO as the target is approached.
- 6.2.12.8.5 When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.
- 6.2.12.8.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds set the switch to CMC.
- 6.2.12.8.7 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.8 Enter the value recorded from R1 in 6.2.12.8.3 into the K-Start. Press the enter pushbutton.
- 6.2.12.8.9 Enter the value recorded from R2 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.10 Sight through the SXT. The SLOS should be centered on Optical Target No. 1 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.3 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.11 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.12 Enter the value recorded from R1 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.

- 6.2.12.8.13 Enter the value recorded from R2 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.14 Sight through the SXT. The SLOS should be centered on Optical Target No. 2 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.5 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.15 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MANUAL.
- 6.2.12.8.16 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start 3 times. Press the ENTER pushbutton after each entry.
- 6.2.13 Optics Slew Rate Test
- NOTE: Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.13.1 Set/verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CB 1530) is +28.0±3.0 VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT. Set TRACKER switch to OFF.
- 6.2.13.2 Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.
- a. VERB 41 NOUN 20, ENTER
  - b. +00000, ENTER
  - c. +00500, ENTER
  - d. +00000, ENTER
- 6.2.13.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the positions indicated.
- a. TELESCOPE TRUNNION to SLAVE to SXT
  - b. CONTROLLER COUPLING to DIRECT
  - c. CONTROLLER SPEED to HI
- 6.2.13.4 Monitor MARK Command by entering VERB 06 NOUN 56 into K-148. Press the ENTER pushbutton.

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6.2.13.4

Trunnion Slew Rate Test HI Speed

### TRUNNION SLEW RATE - HI SPEED

6.2.13.5

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within  $\pm 5$  degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds.

6.2.13.6

Set the OPTICS MODE switch on the G&N Indicator Panel to MAN.

6.2.13.5.1

During the Trunnion Slew Rate Test HI Speed, monitor and verify the following signals on the CRT.

a. SXT TRUNNION TACH O/P (CG 3150 LINK 2) shall be  $3.3 \pm 1.3$  VRMS

b. SCT TRUNNION TACH O/P (CG 3170 LINK 2) shall be  $-0.85 \pm 0.35$  VRMS

NOTE: Read and understand step 6.2.13.6 before proceeding. Do not hold Control Stick at upper limit more than 10 seconds, or exceed a control angle of 85 degrees; Control Stick at upper limit more than 10 seconds, or exceed a control angle of 85 degrees.

6.2.13.6

While slewing the optics, record the SXT TRUN SERVO error (CG 3118); it shall be between  $-0.25$  and  $2.0$  VRMS.

6.2.13.6

Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

a. R2 =  $\Delta XX.XXX$  (Trunnion LOS angle in deg)

b. R3 =  $+XXX.XX$  (Time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.7

Perform the following calculations:

NOTE: In performing calculation b. below, and in similar calculations throughout this test procedure, the following shall be noted and taken into account. It is possible that the second R3 reading may be smaller than the first reading. If so, add an overflow time value of 163.84 sec to the second reading and then subtract the first reading, in order to obtain  $\Delta$  time as the difference of the two R3 readings.

a. Difference between R2 displays = \_\_\_\_\_ ( $\Delta$  trunnion angle)

b. Difference between R3 displays = \_\_\_\_\_ ( $\Delta$  time)

c.  $\frac{\Delta \text{trunnion angle}}{\Delta \text{time}} = \text{deg/sec}$

The Trunnion Slew Rate shall be  $10 \pm 2$  deg/sec.

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# SHAFT SLEW RATE - HI SPEED

6.2.13.8 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the EXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to EXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

6.2.13.8.1 During the Shaft Slew Rate Test - Hi Speed, monitor and verify the following signals on the CRT.

- a. EXT SHAFT TACH O/P (CG 3140 Link 2) shall be  $9.2 \pm 1.3$  VRMS
  - b. SCT SHAFT TACH O/P (CG 3160 Link 2) shall be  $-9.2 \pm 1.3$  VRMS
- NOTE: Read and understand step 6.2.13.9 before proceeding. Do not hold Control Stick at right limit for more than 10 seconds, or exceed a shaft angle of 250 degrees. at right limit for more than 10 seconds, or

6.2.13.9 While slewing the optics, record the EXT SHAFT SERVO error (CG 3117); it shall be between -0.25 and -2.0 VRMS.

6.2.13.9 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R1 = +XXX.XX (shaft angles in deg)
- b. R3 = +XXX.XX (time in seconds)

After the display has changed, again record the values of R1 and R3.

6.2.13.10 Perform the following calculations:

- a. Difference between R1 displays =  $\Delta$  shaft angle
- b. Difference between R3 displays =  $\Delta$  time
- c.  $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{deg/sec}$

The Shaft Slew Rate shall be  $19.5 \pm 3.9$  deg/sec.

## TRUNNION SLEW RATE - MED SPEED

- 6.2.13.11 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to MED. Monitor MARK command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.12 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

- 6.2.13.12 Record the SXT TRUN MTR control winding (CG 3155) and SXT TRUN TACH (CG 3150) signals on the CRT while slewing the optics. CG 3155 shall be  $+0.25$  to  $+2.00$  VRMS, and CG 3150 shall be  $+0.33 \pm 0.13$  VRMS. Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 8 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R2 =  $\pm XX.XXX$  (trunnion LOS angle in deg)
- b. R3 =  $\pm XXX.XX$  (time in seconds)

After the display has changed, again record the values of R2 and R3.

- 6.2.13.13 Perform the following calculations:

- a. Difference between R2 displays =  $\text{---} \cdot \text{---}$  ( $\Delta$  trunnion angle)
- b. Difference between R3 displays =  $\text{---} \cdot \text{---}$  ( $\Delta$  time)
- c.  $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}} = \text{---} \cdot \text{---} \text{ deg/sec}$

The Trunnion Slew Rate shall be  $1.0 \pm 0.2 \text{ deg/sec}$ .

## SHAFT SLEW RATE - MED SPEED

- 6.2.13.14 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS Mode switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.15 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.15  
6.2.13.15

Record the EXT SHAFT MTR control winding (CG 3145), EXT SHAFT MTR and EXT SHAFT TACH (CG 3147) signals on the CRT while slowing the optics. CG 3145 shall be  $\pm 0.50$  to  $\pm 4.00$  VRMS, and CG 3147 shall be  $0.33 \pm 0.15$  VRMS. Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R1 =  $\pm XXX.XX$  (shaft angle in deg)
- b. R3 =  $\pm XXX.XX$  (time in seconds)

After display has changed, again record the values of R1 and R3.

6.2.13.16

Perform the following calculations:

- a. Difference between R1 displays =  $\text{---} \cdot \text{---}$  (A shaft angle)
- b. Difference between R3 displays =  $\text{---} \cdot \text{---}$  (A time)
- c.  $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \text{---} \text{ deg/sec}$

The Shaft Slew Rate shall be  $2.0 \pm 0.4$  deg/sec.

#### TRUNNION SLEW RATE - LO SPEED

6.2.13.17

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the EXT Trunnion to within  $\pm 5$  degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to EXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the Controller SPEED switch to LO. Monitor MARK Command by entering VERB 06 NOUN 06 in K-146. Press the ENTER pushbutton.

6.2.13.17.1

During the Trunnion Slew Rate Test-Lo Speed, monitor and verify the following signal on the CRT.

- a. TRUNNION CDU FINE ERROR (CG 3011 Link 2)  $\pm 0.07$  VRMS MAX

NOTE: Read and understand 6.2.13.16 before proceeding. Do not hold control stick at upper limit for more than 30 seconds.

6.2.13.18

Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R2 =  $\pm XX.XXX$  (trunnion LOS angle in deg)
- b. R3 =  $\pm XXX.XX$  (time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.19 Perform the following calculations:

- a. Difference between R1 displays = XX.XXX (Δ trunnion angle)
- b. Difference between R3 displays = XXX.XX (Δ time)
- c.  $\frac{\Delta \text{trunnion angle}}{\Delta \text{time}} = \text{--- deg/sec}$

The Trunnion Slew Rate shall be  $0.10 \pm 0.02 \text{ deg/sec}$

#### SHAFT SLEW RATE - LO SPEED

6.2.13.20 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Monitor MARK Command by entering Verb 06 NOUN 86 in K-148. Press the ENTER pushbutton.

6.2.13.20.1 During the Shaft Slew Rate Test - Lo Speed, monitor and verify the following signal on the CRT.

- a. SHAFT CDU FINE ERROR (CG 3021 Line 3)  $\pm 0.07 \text{ VRMS MAX}$

NOTE: Read and understand 6.2.13.21 before proceeding. Do not hold control stick at right limit for more than 30 seconds.

6.2.13.21 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R1 = +XXX.XX (shaft angles in deg)
- b. R3 = +XXX.XX (time in seconds)

After the display has changed, again record the values of R1 and R3.

6.2.13.22 Perform the following calculations:

- a. Difference between R1 displays = --- (Δ shaft angle)
- b. Difference between R3 displays = --- (Δ time)
- c.  $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{--- deg/sec}$

The Shaft Slew Rate shall be  $0.20 \pm 0.04 \text{ deg/sec}$



OPTICS HAND CONTROLLER DRIFT RATE CHECK-LO SPEED

6.2.13.23 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

6.2.13.24 Press the MARK pushbutton and record the display in R1, R2, and R3. Approximately 60 seconds after the first MARK, again press the first MARK pushbutton and record the new data displayed in R1, R2 and R3. The data displayed is in the following form:

- a. R1 = +XXX.XX (shaft angle in deg)
- b. R2 = +XX.XXX (trunnion LOS angle in deg)
- c. R3 = +XXX.XX (time in seconds)

6.2.13.25 Perform the following calculations:

- a. Difference between R1 displays = \_\_\_\_\_ (Δ shaft angle)
- b. Difference between R2 displays = \_\_\_\_\_ (Δ trunnion angle)
- c. Difference between R3 displays = \_\_\_\_\_ (Δ time)
- d.  $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{_____ deg/sec (Shaft Drift Rate)}$

Shall be less than 0.0333 deg/sec.

- e.  $\frac{\Delta \text{trunnion angle}}{\Delta \text{time}} = \text{_____ deg/sec (Trunnion Drift Rate)}$

Shall be less than 0.0167 deg/sec.

6.2.13.26 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

Addition 14. Replace Paragraph 6.2.17.5 and 6.2.17.20 with the following:

6.2.17.5 On the G&N Indicator Control Panel, set the following switches to the position indicated.

- a. TELESCOPE TRUNNION to SLAVE to SXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to LO
- d. OPTICS MODE to MAN

6.2.17.20 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN. Enter VERB 33, ENTER into the DSKY.

Addition 15. Replace Paragraphs 6.2.18.10.1, 6.2.18.10.2, 6.2.18.19, 6.2.18.20, and 6.2.18.22 with the following:

6.2.18.10.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Between 235 minutes and 240 minutes from T<sub>0</sub> set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.

6.2.18.10.2 Enter the following into the DSKY:

- a. VERB 21 NOUN 03 ENTER
- b. 02663 ENTER
- c. +XXX.XX±000.01 ENTER (Target No. 1 Az)
- d. Press ENTER pushbutton
- e. 02664 ENTER
- f. +XXX.XX±000.01 ENTER (Target No. 2 Az)
- g. Press ENTER pushbutton
- h. 02665 ENTER
- i. +00.000 ENTER (Target No. 1 EL)
- j. Press ENTER pushbutton
- k. 02666 ENTER
- l. +00.000 ENTER (Target No. 2 EL)

On the G&N Indicator Control Panel, set the OPTICS MODE switch to MAN and the CONTROLLER SPEED switch to HI. Drive the St. LOS to the approximate position of Target No. 1. Set the CONTROLLER SPEED switch to LO.

NOTE: Read the following 10 steps before proceeding. These are time critical steps and must be performed as rapidly as possible.

6.2.18.19 Set the CONTROLLER SPEED switch to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target 2.

6.2.18.20 Set the CONTROLLER SPEED switch to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 2 and press the MARK pushbutton. If satisfied that the MARK was good, press the ENTER pushbutton. If not satisfied, press the MARK REJECT pushbutton and repeat this step.

- 6.2.18.22** Enter VERB 34 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT and DSKY's indicate 02. Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the G&N Indicator Control Panel to Zero.
- Addition 16.** Replace Paragraph 6.2.20.3.2, 6.2.20.3.22, and 6.2.20.3.29 with the following:
- 6.2.20.3.2** Set the OPTICS MODE selector on the Indicator Control Panel to MAN.
- 6.2.20.3.22** Set the OPTICS CONTROLLER SPEED switch on the Indicator Control Panel to HI.
- 6.2.20.3.29** Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the Indicator Control Panel to ZERO for 30 seconds, then return to MAN.

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## ADDENDUM II

**SCOPE:** The following changes are required to make ND1002325 applicable as G&N System technical support documentation for systems containing SUNDIAL C test ropes. Refer to Drawing 2014999 to define further which test ropes and jumper modules shall be installed.

- Change 1:** Paragraphs 6.2.9.1.4, 6.2.9.2a, 6.2.9.3a, 6.2.9.5a, 6.2.9.6a, 6.2.9.7a, 6.2.9.8, 6.2.9.10a, 6.2.9.11a, 6.2.9.13a, 6.2.9.15a, 6.2.9.16a, 6.2.9.22. In each of these paragraphs change "VERB 06 NOUN XX flashing" to "VERB 33 NOUN XX flashing."
- Change 2:** Paragraphs 6.2.20.2.2a, 6.2.20.2.4a, 6.2.20.2.7a, 6.2.20.2.10a, 6.2.20.2.13a, 6.2.20.2.16a, 6.2.20.2.19a, 6.2.20.2.22a, 6.2.20.2.25a, 6.2.20.2.28a, 6.2.20.2.31a, 6.2.20.2.34a, 6.2.20.2.37a, 6.2.20.2.8a, 6.2.20.3.11a, 6.2.20.3.14a, 6.2.20.3.17a, 6.2.20.3.20a, 6.2.20.3.24a, 6.2.20.3.27a, 6.2.20.3.31a, 6.2.20.3.34a, 6.2.20.3.37a, 6.2.20.3.40a; in each of these steps, change "V06" to "V33".
- Change 3:** Paragraph 6.2.16.7.19 Change FROM: On K-148 enter the following sequence:
- |         |         |      |
|---------|---------|------|
| VERB 21 | NOUN 01 | ENTR |
| 00407   |         | ENTR |
| 77757   |         | ENTR |
| VERB 21 | NOUN 01 | ENTR |
| 00411   |         | ENTR |
| 00020   |         | ENTR |
| VERB 33 |         | ENTR |
- Change TO: On K-148 enter the following sequence:
- |         |         |      |
|---------|---------|------|
| VERB 21 | NOUN 01 | ENTR |
| 02502   |         | ENTR |
| 77757   |         | ENTR |
| VERB 21 | NOUN 01 | ENTR |
| 02504   |         | ENTR |
| 00020   |         | ENTR |
| VERB 33 |         | ENTR |
- Change 4:** Paragraph 6.2.16.7.33 Change FROM: On K-148 enter the following sequence:
- |         |         |      |
|---------|---------|------|
| VERB 21 | NOUN 01 | ENTR |
| 00405   |         | ENTR |
| 00020   |         | ENTR |
| VERB 21 | NOUN 01 | ENTR |
| 00407   |         | ENTR |
| 77757   |         | ENTR |
| VERB 33 |         | ENTR |

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ADDENDUM II

Change 4  
(Continued)

Change TO: On K-148 enter the following sequence:

|         |         |      |
|---------|---------|------|
| VERB 21 | NOUN 01 | ENTR |
| 02500   |         | ENTR |
| 00020   |         | ENTR |
| VERB 21 | NOUN 01 | ENTR |
| 02502   |         | ENTR |
| 77757   |         | ENTR |
| VERB 33 |         | ENTR |

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### ADDENDUM III

**SCOPE.** The following changes are required to make ND1002325 applicable on G&N System technical support documentation for CSM 2TV-1.

**Change 1:** Make the changes as specified in Additions 11 through 20 of Addendum I.  
Delete the following paragraphs from Addition 17: 6.2.13.5.1, 6.2.13.8.1,  
6.2.13.17.1, 6.2.13.20.1.

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|         |                 |          |                                                                                                                               | AC        | NASA |
| 8/21/68 | M               | 36708    | 8-13, 33-36, 45, 66, 67, 71, 72, 81, 103-162. Was 162 pages, now 163 pages. Specification now comprises a total of 165 pages. | SB        | WLS  |
|         |                 |          |                                                                                                                               |           |      |
| 9/5/68  | N               | 36791    | 8                                                                                                                             | EA        | WLS  |
|         |                 |          |                                                                                                                               |           |      |
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This specification consists of pages 1 to 163 including Appendix I, pages 138-139, Addendum I, pages 148-160, Addendum II, pages 161-163 and Addendum III, page 163.

|           |                                          |        |              |              |
|-----------|------------------------------------------|--------|--------------|--------------|
| APPROVALS | Not required per CCA-497-0274<br>NASA/MS | MIT/IL | R. D. Petryk | D. A. Ziemer |
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|         |                 |          |                                                                                                                               |           |      |
|         |                 |          |                                                                                                                               |           |      |
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| 9/5/68  | N               | 36791    | 8                                                                                                                             | EA        | WLS  |
| 9/27/68 | P               | 36871    | 66, 67, 68                                                                                                                    | EA        | WLS  |
|         |                 |          |                                                                                                                               |           |      |
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This specification consists of pages 1 to 163 including Appendix I, pages 138-139, Addendum I, pages 140-160, Addendum II, pages 161-162 and Addendum III, page 163.

|           |                                  |  |        |             |             |
|-----------|----------------------------------|--|--------|-------------|-------------|
| APPROVALS | Not required per CCA-497-NASA/MS |  |        | R.D. Petryk | D.A. Ziemer |
|           |                                  |  | MIT/IL | AC          |             |



6.2.9 Semi-Automatic Moding Check

6.2.9.1 Perform Master Initialization 6.2.5.3 before proceeding.

6.2.9.1.1 Enter the following sequence manually per 6.2.9.1.1.1 and 6.2.9.1.1.2 or tape load the sequence per steps 6.2.9.1.2.1 thru 6.2.9.1.2.5.

6.2.9.1.1.1 On K-148, enter the following sequence:

|     |                 |           |
|-----|-----------------|-----------|
| a.  | VERB 21 NOUN 01 | ENTR      |
| b.  | 01300           | ENTR      |
| c.  | 40200           | ENTR      |
| d.  | NOUN 15         | ENTR      |
| e.  | 01304           | ENTR ENTR |
| f.  | 10000           | ENTR ENTR |
| g.  | 01325           | ENTR ENTR |
| h.  | 00023           | ENTR ENTR |
| i.  | 01325           | ENTR ENTR |
| j.  | 25546           | ENTR ENTR |
| k.  | 31344           | ENTR ENTR |
| l.  | 54324           | ENTR ENTR |
| m.  | 41345           | ENTR ENTR |
| n.  | 00150           | ENTR ENTR |
| o.  | 10000           | ENTR ENTR |
| p.  | 01332           | ENTR ENTR |
| q.  | 00050           | ENTR ENTR |
| r.  | 01332           | ENTR ENTR |
| s.  | 37640           | ENTR ENTR |
| t.  | 04451           | ENTR ENTR |
| u.  | 01337           | ENTR ENTR |
| v.  | 30005           | ENTR ENTR |
| w.  | 02324           | ENTR ENTR |
| x.  | 04505           | ENTR ENTR |
| y.  | 31315           | ENTR ENTR |
| z.  | 04451           | ENTR ENTR |
| aa. | 01300           | ENTR ENTR |
| ab. | 30005           | ENTR ENTR |
| ac. | 04505           | ENTR ENTR |
| ad. | 31315           | ENTR ENTR |
| ae. | 04451           | ENTR ENTR |
| af. | 01307           | ENTR ENTR |
| ag. | 30005           | ENTR ENTR |
| ah. | 04505           | ENTR ENTR |
| ai. | 31344           | ENTR ENTR |
| aj. | 54150           | ENTR ENTR |
| ak. | 54331           | ENTR ENTR |
| al. | 05572           | ENTR ENTR |
| am. | 04505           | ENTR ENTR |
| an. | 00002           | ENTR ENTR |
| ao. | 30364           | ENTR ENTR |
| ap. | 30376           | ENTR      |
| aq. | VERB 25 NOUN 26 | ENTR      |
| ar. | 00001           | ENTR      |
| as. | 01300           | ENTR      |
| at. | 30005           | ENTR      |
| au. | VERB 31         | ENTR      |

- 6.2.9.1.1.2 Proceed to 6.2.9.1.3 after manual entry of above data.
- 6.2.9.1.2 Tape loaded input.
- 6.2.9.1.2.1 Verify K-START Tape N 05C106-K10540-XX, SAMOD INHINT GUARD, is on K-START tape reader. XX equals tape revision number.
- 6.2.9.1.2.2 Start tape reader
- 6.2.9.1.2.3 When tape reader stops, verify the following on the CRT
- R1 = +05003
  - R2 = +10540
  - R3 = -000XX (XX = tape revision number.)
- 6.2.9.1.2.4 Start tape reader.
- 6.2.9.1.2.5 When tape reader stops, verify the following on the CRT
- R1 = 00101
- 6.2.9.1.3 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Record the indication on the CRT. Verify that OPTX 28V 800 cps 1% Oph (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.
- 6.2.9.1.4 Enter VERB 57 into K148. Press the ENTER pushbutton.
- 6.2.9.1.5 Enter 00010 into K148. Press the ENTER pushbutton.
- 6.2.9.1.6 Observe VERB 06 NOUN 01 flashes on the CRT and the PROGRAM display indicates 07.
- 6.2.9.2 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 30 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 03 flashing
  - b. R1 = +00000±00007
  - c. R2 = +00000±00007
  - d. R3 = +00000±00007
  - e. IG angle = 000±1 deg.
  - f. MG angle = 000±1 deg.
  - g. OG angle = 000±1 deg.
- 6.2.9.3 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 03 flashing
  - b. R1 = +04500±00007
  - c. R2 = +04500±00007
  - d. R3 = +04500±00007
  - e. IG angle = 045±1 deg.
  - f. MG angle = 045±1 deg.
  - g. OG angle = 045±1 deg.
- 6.2.9.4 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall extinguish. After approximately 100 seconds the following data shall be displayed on the CRT.
- a. VERB 06 NOUN 30 flashing
  - b. R1 = 00000±00003

6.2.9.4  
(Continued)

- c. R2 = 00000±00003
- d. R3 = 00000±00003

NOTE: Negative numbers will be displayed in octal complement form, i.e.,  
00001 = 77776.

6.2.9.5

Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 05 flashing
- b. R1 = +07100±00007
- c. R2 = +07100±00007
- d. R3 = +07100±00007
- e. IG angle = 071±1 deg.
- f. MG angle = 071±1 deg.
- g. OG angle = 071±1 deg.

The GIMBAL LOCK lamps on the DSKY's shall light. The PGNS caution lamp on the Indicator Control Panel shall light.

6.2.9.6

Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 06 flashing
- b. R1 = +09000±00007
- c. R2 = +09000±00007
- d. R3 = +09000±00007
- e. IG angle = 090±1 deg.
- f. MG angle = 090±1 deg.
- g. OG angle = 090±1 deg.

6.2.9.7

Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 07
- b. R1 = +13500±00007
- c. R2 = +13500±00007
- d. R3 = +13500±00007
- e. IG angle = 135±1 deg.
- f. MG angle = 135±1 deg.
- g. OG angle = 135±1 deg.

6.2.9.8

Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds VERB 06 NOUN 10 shall flash. The GIMBAL LOCK lamp shall extinguish on the DSKY's. The PGNS caution lamp on the Indicator Control Panel shall extinguish. The gimbal angles shall be approximately 135°, 135°, and 45° respectively.

6.2.9.9

Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall extinguish. After approximately 100 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 30 flashing
- b. R1 = 00000±00003
- c. R2 = 00000±00003
- d. R3 = 00000±00003

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| 9/5/68   | N               | 36791    | 6 <i>WLS/AC</i>                                                                                                                             | EA        | WLS  |
| 9/27/68  | P               | 36871    | 66, 67, 68 <i>WLS/AC</i>                                                                                                                    | EA        | WLS  |
| 10/24/68 | R               | 36854    | 58, 112, 113, 115, 116, 117 through 167. Was 163 pages; now 167 pages. <i>WLS/AC</i>                                                        | EA        | WLS  |
|          |                 |          |                                                                                                                                             |           |      |
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|           |                                   |        |             |             |
|-----------|-----------------------------------|--------|-------------|-------------|
| APPROVALS | Not required per CCA-497-NASA/MSC | MIT/IL | R.D. Petryk | D.A. Ziemer |
|           |                                   |        |             |             |

6.2.17 EXT-NB-IMU Fine Alignment Test

6.2.17.1 Perform Master Initialization 6.2.5.3 before proceeding.

6.2.17.2 Prior to performing this test, the G&N Installation Qualification fixture shall be installed on the supporting fixture and adjusted to permit proper operation of the G&N optics. The azimuth supplied by the azimuth autoseal (Optical Reference No. 1) shall be known to  $\pm 30$  minutes of arc.

NOTE: The G&N shall have had OPERATE power applied for a minimum of 1 hour. Set the G/N POWER-OPTICS switch to OPTICS. Verify that +25 VDC OPTICS OPERATE BUS (CG 1530) is +25.0  $\pm$  3.0 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.

6.2.17.3 Enter VERB 01 NOUN 10 into KI48. Press the ENTER pushbutton. Enter 00003 into KI48. Press the ENTER pushbutton. Record R1 = AAAAA.

If the recorded value is within any of the sets of limits given in Table 1 proceed with the test. If the recorded value is NOT within any of the sets of limits, wait 30 minutes and then repeat this step or enter VERB 11 NOUN 10 ENTER, 00003 ENTER and proceed when the monitored value is within the limits set in Table 1.

TABLE I

| MIN VALUE |       | MAX VALUE |
|-----------|-------|-----------|
| 00000     | AAAAA | 08100     |
| 04000     | AAAAA | 07200     |
| 10000     | AAAAA | 13100     |
| 14000     | AAAAA | 17100     |
| 20000     | AAAAA | 23100     |
| 24000     | AAAAA | 27100     |
| 30000     | AAAAA | 33100     |
| 34000     | AAAAA | 37100     |

6.2.17.4 Enter the following sequence into the Lower Equipment Bay (LEB) DSKY.

- a. VERB 41 NOUN 20 ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.17.5 On the G&N Indicator Control Panel set the following switches to the position indicated.

- a. OPTICS TEL TRUN to SLAVE to EXT
- b. OPTICS COUPLING to DIRECT
- c. OPTICS SPEED to LO
- d. OPTICS MODE to MAN

6.2.17.5.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the EXT Trunnion to within  $\pm 5$  degrees of zero as indicated by the TPAC. Set OPTICS ZERO to ZERO.

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6.2.17.6 Enter the following into the DSKY.

- a. VERB 01 NOUN 01, ENTER
- b. 00362, ENTER
- Record R1 = XXXXY

6.2.17.7 Enter the following into the DSKY

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER, where Y' is determined by table below and XXXX is that recorded in 6.2.17.6.

TABLE II

| Y (From 6.2.17.6) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|-------------------|---|---|---|---|---|---|---|---|
| Y'                | 2 | 3 | 2 | 3 | 6 | 7 | 6 | 7 |

6.2.17.8 Initiate the test by entering the following sequence into the LEB DSKY.

- a. VERB 57, ENTER
- b. 00003, ENTER

6.2.17.9 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data is displayed in R1 and R2 on the DSKY.

- a. R1 = +13500
- b. R2 = +xx.xxx (Site Latitude from Table I)

TABLE I

| Test Site | Latitude |
|-----------|----------|
| NAA       | +33.922  |
| MILA      | +28.516  |
| MSC       | +29.556  |

6.2.17.10 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If the value displayed is other than +13500 in R1 and the correct Site Latitude in R2, correct the data by entering the following sequence into the DSKY.

- a. VERB 21, ENTER
- b. +13500, ENTER
- c. VERB 22, ENTER
- d. +xx.xxx, ENTER (+xx.xxx = Site Latitude from Table I)
- e. VERB 33, ENTER

6.2.17.11 Observe VERB 21 NOUN 30 flashing on the DSKY. Enter the following sequence into the DSKY.

- a. +00001, ENTER (Position Number)
- b. +00000, ENTER
- c. +00001, ENTER

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|        |                 |  |  |  |  |  |      |

- 6.2.17.19 If the data displayed is correct proceed to 6.2.17.20. If R1 and R2 do not contain the correct azimuth and elevation for Target 2, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
  - XXXX.XXX000.10 degrees, ENTER (Target 2 Azimuth)
  - XXX.XXX00.010 degrees, ENTER (Target 2 Elevation)
- 6.2.17.20 Set the OPTICS ZERO switch to OFF. Enter VERB 33, ENTER into the DSKY.
- 6.2.17.21 When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00001, set the OPTICS MODE switch on the G&N Indicator Control Panel to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.
- 6.2.17.22 Using the Optics Hand Controller, align the SXT StLOS with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.23 When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00002 set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.
- 6.2.17.24 Using the Optics Hand Controller, align the SXT StLOS with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.
- NOTE: The following two MARKS must be performed as quickly as possible. In no case shall the time between the first and second MARK exceed two minutes.
- 6.2.17.25 After 90 seconds observe the DSKY for VERB 51 NOUN 30 flashing and R1 = 00001. Set the Optics Mode switch to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.
- 6.2.17.26 Using the Optics Hand Controller, align the SXT StLOS with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.

6. 2. 17. 27 When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00002 set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.
6. 2. 17. 28 Using the Optics Hand Controller, align the SXT StLOS with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.
6. 2. 17. 29 In approximately 7 minutes VERB 06 NOUN 66 shall flash on the DSKY and the test results shall be displayed. R1 and R2 on the DSKY shall display the misalignment of one of the horizontal PIPA's in arc seconds (R1 = whole, R2 = fractional). Record R1 and R2. (See Table II for PIPA displayed).
6. 2. 17. 30 Enter VERB 33 ENTER into the DSKY. When VERB 06 NOUN 66 flashes, R1 and R2 on the DSKY shall display the misalignment of the second horizontal PIPA in arc seconds (R1 whole, R2 fractional). (See Table II for PIPA displayed.) Record R1 and R2.
6. 2. 17. 31 Enter VERB 34 ENTER into the DSKY to terminate the test. Wait 5 seconds.
6. 2. 17. 32 Repeat steps 6. 2. 17. 3 and 6. 2. 17. 8 through 6. 2. 17. 31 substituting No. +00002 in 6. 2. 17. 11. a.
6. 2. 17. 33 Repeat Step 6. 2. 17. 3.
6. 2. 17. 34 On the G&N Indicator Control Panel, verify the following switches in the positions indicated.
- a. OPTICS TEL TRUN to SLAVE to SXT
  - b. OPTICS COUPLING to DIRECT
  - c. OPTICS SPEED to LO
  - d. OPTICS MODE to MAN
6. 2. 17. 34. 1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC. Set OPTICS ZERO to ZERO.
6. 2. 17. 35 Enter the following into the DSKY:
- a. VERB 21 NOUN 01 ENTR
  - b. 02542 ENTR
  - c. 00001 ENTR ENTR
  - d. 02543 ENTR
  - e. 00002 ENTR
6. 2. 17. 36 Repeat Steps 6. 2. 17. 8 through 6. 2. 17. 10.



6. 2. 17. 37      Observe VERB 21 NOUN 30 flashing on the DSKY. Enter the following sequence into the DSKY.
- a. +00005, ENTER (Option Number)
  - b. +00000, ENTER
  - c. +00001, ENTER
6. 2. 17. 38      Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- a. R1 = +XXX.XX (Y<sub>NB</sub> Azimuth)
  - b. R2 = ±XX.XXX (Y<sub>NB</sub> Elevation)
  - c. R3 = 00001
6. 2. 17. 39      If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct Y<sub>NB</sub> azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- a. VERB 24, ENTER
  - b. +XXX.XX±002.00 degrees, ENTER (Y<sub>NB</sub> Azimuth)
  - c. +XX.XXX±02.000 degrees, ENTER (Y<sub>NB</sub> Elevation)
  - d. VERB 33, ENTER
6. 2. 17. 40      Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- a. R1 = +XXX.XX (Z<sub>NB</sub> Azimuth)
  - b. R2 = ±XX.XXX (Z<sub>NB</sub> Elevation)
  - c. R3 = 00002
6. 2. 17. 41      If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct Z<sub>NB</sub> azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- a. VERB 24, ENTER
  - b. +XXX.XX±002.00 degrees, ENTER (Z<sub>NB</sub> Azimuth)
  - c. +XX.XXX±02.000 degrees, ENTER (Z<sub>NB</sub> Elevation)
  - d. VERB 33, ENTER
6. 2. 17. 42      When VERB 06 NOUN 61 flashes on DSKY, enter the following:
- a. VERB 24 ENTR
  - b. +13500 ENTR
  - c. +00000 ENTR
6. 2. 17. 43      Observe R3 = 00001. Enter VERB 33 ENTR.

6. 2. 17. 44      When VERB 06 NOUN 61 flashes on DSKY, enter the following:
- a. VERB 24 ENTR
  - b. +22500 ENTR
  - c. +00000 ENTR
6. 2. 17. 45      Observe R3 = 00002. Enter VERB 33 ENTR.
6. 2. 17. 46      Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- a. R1 = +XXX.XX (Target 1 Azimuth)
  - b. R2 = ±XX.XXX (Target 1 Elevation)
  - c. R3 = 00001
6. 2. 17. 47      If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct azimuth and elevation for Target 1, correct the data by entering the following sequence into the DSKY.
- a. VERB 24, ENTER
  - b. +XXX.XX±000.10 degrees, ENTER (Target 1 Azimuth)
  - c. ±XX.XXX±00.010 degrees, ENTER (Target 1 Elevation)
  - d. VERB 33, ENTER
6. 2. 17. 48      Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- a. R1 = +XXX.XX (Target 2 Azimuth)
  - b. R2 = ±XX.XXX (Target 2 Elevation)
  - c. R3 = 00002
6. 2. 17. 49      If the data displayed is correct proceed to 6. 2. 17. 50. If R1 and R2 do not contain the correct azimuth and elevation for Target 2, correct the data by entering the following sequence into the DSKY.
- a. VERB 24, ENTER
  - b. ±XXX.XX±000.10 degrees, ENTER (Target 2 Azimuth)
  - c. ±XX.XXX±00.010 degrees, ENTER (Target 2 Elevation)
6. 2. 17. 50      Set the OPTICS ZERO switch to OFF. Enter VERB 33, ENTER into the DSKY.
6. 2. 17. 51      When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00001, set the OPTICS MODE switch on the G&N Indicator Control Panel to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.

- 6.2.17.52 Using the Optics Hand Controller, align the SXT SLOS with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.53 When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00002 set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.
- 6.2.17.54 Using the Optics Hand Controller, align the SXT SLOS with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.
- NOTE: The following two MARKS must be performed as quickly as possible. In no case shall the time between the first and second MARK exceed two minutes.
- 6.2.17.55 After 90 seconds observe the DSKY for VERB 51 NOUN 30 flashing and R1 = 00001. Set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.
- 6.2.17.56 Using the Optics Hand Controller, align the SXT SLOS with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.57 When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00002 set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.
- 6.2.17.58 Using the Optics Hand Controller, align the SXT SLOS with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.59 In approximately 7 minutes VERB 06 NOUN 66 shall flash on the DSKY and the test results shall be displayed. R1 and R2 on the DSKY shall display the misalignment of one of the horizontal PIPA's in arc-seconds (R1 = whole, R2 = fractional). Record R1 and R2. (See Table II for PIPA displayed).

6. 2. 17. 60 Enter VERB 33 ENTER into the DSKY. When VERB 06 NOUN 66 flashes, R1 and R2 on the DSKY shall display the misalignment of the second horizontal PIPA in arc-seconds (R1 = whole, R2 = fractional). (See Table II for PIPA displayed). Record R1 and R2.
6. 2. 17. 61 Enter VERB 34 ENTER into the DSKY to terminate the test. Wait 5 seconds.
6. 2. 17. 62 Repeat Steps 6. 2. 17. 33 through 6. 2. 17. 61, substituting numbers as follows:
- 00000 in Step 6. 2. 17. 35. a  
00001 in Step 6. 2. 17. 35. e
- +00000 in Step 6. 2. 17. 44. b  
+89999 in Step 6. 2. 17. 44. c
6. 2. 17. 63 Enter the following into the DSKY:
- a. VERB 36 ENTER
  - b. VERB 41 NOUN 20 ENTER
  - c. +00000 ENTER
  - d. +00000 ENTER
  - e. +00000 ENTER

TABLE II. Display Conditions at Test Completion

| Position | SM Orientation  |                 |                 | Horizontal Misalignment Component |                    |
|----------|-----------------|-----------------|-----------------|-----------------------------------|--------------------|
|          | X <sub>SM</sub> | Y <sub>SM</sub> | Z <sub>SM</sub> | 6. 2. 17. 29 & .59                | 6. 2. 17. 30 & .60 |
| 1        | UP              | SW              | SE              | Y <sub>SM</sub>                   | Z <sub>SM</sub>    |
| 2        | SE              | SW              | DN              | X <sub>SM</sub>                   | Y <sub>SM</sub>    |
| 4        | DN              | SE              | SW              | Y <sub>SM</sub>                   | Z <sub>SM</sub>    |
| 5        | SW              | SE              | UP              | X <sub>SM</sub>                   | Y <sub>SM</sub>    |

6. 2. 17. 64 Set the G/N POWER-OPTICS switch on the LEM Lighting Control Panel to OFF.
6. 2. 17. 65 Calculations
6. 2. 17. 65. 1
- a.  $Y_{SM} \text{ misalignment} = () \frac{R1 \cdot R2}{}$
  - b.  $Z_{SM} \text{ misalignment} = () \frac{R1 \cdot R2}{}$
  - c.  $X_{SM} \text{ misalignment} = () \frac{R1 \cdot R2}{}$
  - d.  $Y_{SM} \text{ misalignment} = () \frac{R1 \cdot R2}{}$
  - e.  $Y_{SM} \text{ misalignment} = () \frac{R1 \cdot R2}{}$
  - f.  $Z_{SM} \text{ misalignment} = () \frac{R1 \cdot R2}{}$
  - g.  $X_{SM} \text{ misalignment} = () \frac{R1 \cdot R2}{}$
  - h.  $Y_{SM} \text{ misalignment} = () \frac{R1 \cdot R2}{}$

6.2.17.65.2 Enter the latest values from 6.2.16 IMU Performance Test

- a. X PIPA bias = \_\_\_\_\_ cm/sec<sup>2</sup>
- b. Y PIPA bias = \_\_\_\_\_ cm/sec<sup>2</sup>
- c. Z PIPA bias = \_\_\_\_\_ cm/sec<sup>2</sup>
- d.  $\theta_X = 210$  (X PIPA bias) = \_\_\_\_\_ arc-sec.
- e.  $\theta_Y = 210$  (Y PIPA bias) = \_\_\_\_\_ arc-sec.
- f.  $\theta_Z = 210$  (Z PIPA bias) = \_\_\_\_\_ arc-sec.

6.2.17.65.3

- a.  $Z_{SM}$  misalignment (bias corrected) =  
6.2.17.65.1.b -  $\theta_Z$  = \_\_\_\_\_ arc-sec.
- b.  $X_{SM}$  misalignment (bias corrected) =  
6.2.17.65.1.c -  $\theta_X$  = \_\_\_\_\_ arc-sec.
- c.  $Y_{SM}$  misalignment (bias corrected) =  
6.2.17.65.1.e -  $\theta_Y$  = \_\_\_\_\_ arc-sec.
- d.  $Y_{SM}$  misalignment (bias corrected) =  
6.2.17.65.1.h -  $\theta_Y$  = \_\_\_\_\_ arc-sec.

The SM misalignments in each orientation, excluding PIPA bias, shall not exceed  $\pm 150$  arc-seconds.

6.2.18

Gyrocompassing Test

NOTE: Perform Master Initialization 6.2.5.3 before proceeding.

6.2.18.1

Set the G/N POWER-OPTICS Switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0 $\pm$ 3.0 VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90°h (CG 1212) are not flashing on the CRT.

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6.2.18.2 Enter the following into the DSKY.

- a. VERB 01 NOUN 01, ENTER
- b. 00362, ENTER
- Record R1 = XXXXY

6.2.18.3 Enter the following into the DSKY.

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table II and XXXX is that recorded in 6.2.18.2.

Table II

|                   |   |   |   |   |   |   |   |   |
|-------------------|---|---|---|---|---|---|---|---|
| Y (From 6.2.18.2) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Y'                | 2 | 3 | 2 | 3 | 6 | 7 | 6 | 7 |

6.2.18.4 Enter the following sequence into the K-Start, pressing ENTER pushbutton after each entry.

- a. VERB 57, ENTER
- b. 00006, ENTER

6.2.18.5 System shall advance to Gyrocompass System Test and display 01 on the CRT program display.

6.2.18.6 On the CRT observe VERB 06, NOUN 61 flashing with some launch azimuth displayed in R1 = +XXX.XX.

6.2.18.6.1 If the azimuth displayed is correct proceed to 6.2.18.5; if not, perform the following sequence:

- a. VERB 21, Press ENTER pushbutton
- b. +XXX.XX, press ENTER pushbutton (Correct Launch Azimuth)

6.2.18.7 After verifying that the correct launch azimuth is displayed in R1 on the CRT, Enter VERB 33 on the K-START and push the ENTER pushbutton.

6.2.18.8 Observe VERB 06 NOUN 61 flashing on the CRT with the following displayed in R1 and R2.

- a. R1 = +XXX.XX, Nav. Base Azimuth (Z<sub>NB</sub>)
- b. R2 = +XX.XXX, Site Latitude

6.2.18.8.1 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence:

To correct R1:

- a. VERB 21, ENTER
- b. +XXX.XX+000.50 degrees, ENTER (Z<sub>NB</sub> Azimuth)

To correct R2:

- a. Verb 22, ENTER
- b. +XX.XXX, ENTER (Correct Site Latitude from Table I)

- 6.2.18.9 Gyrocompassing Stability
- 6.2.18.9.1 Enter VERB 33, ENTER into the DSKY. On the DSKY observe the PROGRAM display change to 05 after approximately 90 seconds. Approximately 5 minutes later observe the PROGRAM display change to 02. When PROG display changes to 02 record time as  $T_0$ .
- 6.2.18.9.2 120 minutes after  $T_0$  record the Outer, Inner and Middle CDU Gimbal angles from the CRT.
- 6.2.18.9.3 Repeat above step every 5 minutes for the next 60 minutes.
- 6.2.18.9.4 The peak-to-peak spread of the outer gimbal angle shall not exceed 0.12 degrees.
- 6.2.18.9.5 The peak-to-peak spread of the Inner and Middle gimbal angles shall not exceed 0.06 degrees.
- 6.2.18.10 Gyrocompassing Accuracy
- 6.2.18.10.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within  $\pm 5$  degrees of zero as indicated by the TFAC (Telescope Trunnion slaved to SXT). Between 175 minutes and 180 minutes from  $T_0$  set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.10.2 Enter the following into the DSKY.
- a. VERB 21 NOUN 03 ENTER
  - b. 02663 ENTER
  - c. +XXX.XX+000.01 ENTER (Target No. 1 Az)
  - d. Press ENTER Pushbutton
  - e. 02664 ENTER
  - f. +XXX.XX+000.01 ENTER (Target No. 2 Az)
  - g. Press ENTER Pushbutton
  - h. 02665 ENTER
  - i. +00.000 ENTER (Target No. 1 EL)
  - j. Press ENTER Pushbutton
  - k. 02666 ENTER
  - l. +00.000 ENTER (Target No. 2 EL)
- On the G&N Indicator Control Panel set the OPTICS ZERO switch to OFF, set the OPTICS MODE switch to MAN and the OPTICS SPEED switch to HI. Drive the SLOS to the approximate position of Target No. 1. Set the OPTICS SPEED Switch to LO.
- NOTE: Read the following 10 steps before proceeding. These are time critical steps and must be performed as rapidly as possible.
- 6.2.18.11 After 180 minutes from  $T_0$  enter VERB 53 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT change to 03.

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- 6.2.18.12 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 1 azimuth and elevation.
- a. R1 = +xxx.xx (Target 1 azimuth)
  - b. R2 = +00.000 (Target 1 elevation)
- 6.2.18.13 Verify the data appearing in R1 and R2 and if correct, proceed. If not correct, perform the following sequence.
- a. VERB 24, ENTER
  - b. +xxx.xx±000.01, ENTER (Target 1 azimuth)
  - c. +00.000, ENTER (Target 1 elevation)
- 6.2.18.14 After the correct readings for R1 and R2 are verified, enter VERB 33 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.15 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 2 azimuth and elevation.
- a. R1 = +xxx.xx (Target 2 azimuth)
  - b. R2 = +00.000 (Target 2 elevation)
- 6.2.18.16 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence.
- a. VERB 24, ENTER
  - b. +xxx.xx±000.01, ENTER (Target 2 azimuth)
  - c. +00.000, ENTER (Target 2 elevation)



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- 6.2.18.17 After the correct readings for R1 and R2 are verified enter VERB 33 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.18 Using the Optics Hand Controller, align the SXT StLOS to target 1 and press the MARK pushbutton. If satisfied that the MARK was good, proceed. If not satisfied with MARK, press the MARK REJECT pushbutton and repeat the step.
- 6.2.18.19 Set the OPTICS SPEED switch to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target No. 2.
- 6.2.18.20 Set the OPTICS SPEED switch to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 2 and press the MARK pushbutton. If satisfied that the MARK was good, press the ENTER pushbutton. If not satisfied, press the MARK REJECT pushbutton and repeat this step.
- 6.2.18.21 On the CRT observe the following data displayed:
- a. VERB 06 NOUN 60
  - b. R1 = ±xx.xxx (X gyro elevation error, degrees)
  - c. R2 = ±xx.xxx (Y gyro elevation error, degrees)
  - d. R3 = ±xx.xxx (Z gyro azimuth error, degrees)
- Record R1, R2 and R3.
- 6.2.18.22 Enter VERB 34 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT and DSKY's indicate 02. Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.23 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.24 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start three times. Press the ENTER pushbutton after each entry. Set the G/N POWER OPTICS Switch on the LEB Lighting Control Panel to OFF.

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6.2.18.25 Data Sheet

| TIME    | CDUX | CDUY | CDUZ |
|---------|------|------|------|
| To      |      |      |      |
| To +15  |      |      |      |
| To +30  |      |      |      |
| To +45  |      |      |      |
| To +60  |      |      |      |
| To +75  |      |      |      |
| To +90  |      |      |      |
| To +105 |      |      |      |
| To +120 |      |      |      |
| To +125 |      |      |      |
| To +130 |      |      |      |
| To +135 |      |      |      |
| To +140 |      |      |      |
| To +145 |      |      |      |
| To +150 |      |      |      |
| To +155 |      |      |      |
| To +160 |      |      |      |
| To +165 |      |      |      |
| To +170 |      |      |      |
| To +175 |      |      |      |
| To +180 |      |      |      |

- NOTES: 1. Record CDU angles at times indicated. ( $T_0$  is the time at the start of test - Prog 02)
2. The 2 hr data ( $T_0 + 120$  minutes) is baseline.

Tolerance: Tolerance is  $0.00 \pm 0.06^\circ$  delta from 2 hr baseline for CDUX, and  $0.00 \pm 0.03^\circ$  delta from 2 hr baseline for CDUY & CDUZ for the 120 minute to 180 minute recordings only.

| Line | Step      | Parameter              | Recorded Value   |
|------|-----------|------------------------|------------------|
| 1    | 6.2.18.21 | X Gyro Elevation Error | $\pm R1$ degrees |
| 2    |           | Y Gyro Elevation Error | $\pm R2$ degrees |
| 3    |           | Z Gyro Azimuth Error   | $\pm R3$ degrees |

6.2.18.26 Calculation Sheet

6.2.18.26.1 Record the most recent values of the following coefficients from 6.2.18, IMU Performance Test.

- a. NBDX = ( ) \_\_\_\_\_
- b. NBDY = ( ) \_\_\_\_\_
- c. NBDZ = ( ) \_\_\_\_\_
- d. ADIAZ = ( ) \_\_\_\_\_
- e. ADSRAY = ( ) \_\_\_\_\_

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6.2.18.26.2 Perform the following calculations. (Cos  $\lambda$  functions are provided in Table I.)

- a.  $D_{(vert)} = NBDZ + ADIAZ$   
 $D_{(vert)} = ( )$  \_\_\_\_\_ meru
- b.  $D_{(east)} = \sin (\text{Launch Az}) NBDX +$   
 $\cos (\text{Launch Az}) NBDY + ADSEAY$
- c.  $\phi_{(vert)} = \frac{D_{(vert)} \times \cos \lambda + D_{(east)} \times \frac{206}{\cos \lambda}}{3600}$   
 $\phi_{(vert)} = ( )$  \_\_\_\_\_ degrees

Table I

| Location | Latitude $\lambda$ | Cos $\lambda$ |
|----------|--------------------|---------------|
| NAA      | 33.921             | 0.82985       |
| MILA     | 28.516             | 0.87868       |
| MSC      | 29.556             | 0.86993       |

6.2.18.26.3 Perform the following calculations using the recorded data from 6.2.18.25 and 6.2.18.26.2.

- a. Z Gyro azimuth error 3 hrs (corrected) = line 3 -  $\phi_{(vert)}$   
Z Gyro azimuth error 3 hrs (corrected) = \_\_\_\_\_ corrected  
Z Gyro azimuth error (corrected) shall be  $0.00 \pm 0.573$  degrees.
- b. X Gyro elevation error (3 hr) = line 1 \_\_\_\_\_  
X Gyro elevation error (3 hr) = \_\_\_\_\_ degrees
- c. Y Gyro elevation error (3 hr) = line 2 \_\_\_\_\_  
Y Gyro elevation error (3 hr) = \_\_\_\_\_ degrees  
The X and Y Gyro elevation errors shall be  $0.00 \pm 0.045$  degrees.

6.2.19 CMC Voltage Margin Test

6.2.19.1 Verify that the G&N IMU HTR MNA and MNB breakers are engaged, computer MNA and MNB breakers are engaged, IMU MNA and MNB breakers are not engaged, and the G&N Power-IMU switch on the LEB Lighting Control Panel is in the OFF position. On K-148, enter VERB 36 ENTR.

6.2.19.2 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to ON.

**CAUTION:** During the performance of this test the +4 VDC CMC Power Supply shall not be operated at less than +2.5 VDC or greater than 5.2 VDC (CG 1030). The +14 VDC CMC Power Supply shall not be operated at less than +8.5 VDC or greater than +17.0 VDC (CG 1020). Rotate the LEB LTS NUMERICS SEL to approximately center position. Decrease to absolute minimum

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6.2.19.2 discernible lighting.  
(cont)

NOTE: The flashing indication of the CMC Power Supplies on CRT may be disregarded for this test. The charts in Table I may be used to determine approximate values for the "XX.X" values of C-156 voltage dial settings corresponding to various power supply voltages.

6.2.19.2.1 Into R-153, insert 1100. Verify and execute.

6.2.19.3 Units R-154, insert 0001. Verify and execute.

6.2.19.4 Insert in C-156, -040001244 and execute. Verify on CRT that GV0116 is between -3.0 and -5.0 vdc.

6.2.19.5 Insert in C-156 -050001234 and execute. Verify on CRT that GV0106 is between -4.0 and -6.0 vdc.

6.2.19.6 Units R-154, insert 0111. Verify and execute.

6.2.19.7 Observe CG 1020, +14 VDC Power Supply, and CG 1030, +4 VDC Power Supply on CRT. Repeat 6.2.19.3 through 6.2.19.6 adjusting each C Start entry until CG 1020 is 12.1, +0.1, -0.0 vdc and CG 1030 is 3.40, +0.03, -0.00 vdc.

6.2.19.8 Initiate CMC Self Check by inserting the following in K-148.

- a. ERROR RESET
- b. VERB 21, NOUN 27, ENTER
- c. 77777, ENTER

Wait 200 seconds.

6.2.19.9 Insure that the DSKY RESTART lamp does not light, and that

- a. VERB 05 NOUN 31
  - b. R1 = 01102
- does not appear on DSKY.

6.2.19.9.1 Into R-154, insert 0101. Verify and execute.

6.2.19.10 Set INHIBIT VOLTAGE FAIL switch to OFF on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. If RESTART lamp does not light, repeat 6.2.19.3. Verify CMC Warning master alarms are lighted.

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- 6.2.19.11 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- ERROR RESET
  - VERB 21, NOUN 27, ENTER
  - 77777, ENTER
- 6.2.19.12 Units R-154, insert 0001. Verify and execute.
- 6.2.19.13 Insert in C-156 +108001244 and execute. Verify on CRT that GV0116 is between +0.8 and +11.8 vdc.
- 6.2.19.14 Units R-154, insert 0111. Verify and execute.
- 6.2.19.15 Observe CG 1020, +14 VDC Power Supply on CRT. Repeat 6.2.19.12 through 6.2.19.14 adjusting the C Start entry until CG 1020 is 16.4, +0.1, -0.0 vdc.
- 6.2.19.16 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- YEMB 05, NOUN 31
  - R1 = 01102
- does not appear on DSKY
- 6.2.19.16.1 Into R-154, insert 0011. Verify and execute.
- 6.2.19.17 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted.
- 6.2.19.18 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- ERROR RESET
  - VERB 21, NOUN 27, ENTER
  - 77777, ENTER
- 6.2.19.19 Units R-154, insert 0001. Verify and execute.
- 6.2.19.20 Insert in C-156, +092001234 and execute. Verify on CRT that GV0106 is between +8.2 and +10.2 vdc.
- 6.2.19.21 Units R-154, insert 0111. Verify and execute.
- 6.2.19.22 Observe CG 1030, +4 VDC Power Supply on CRT. Repeat 6.2.19.19 through 6.2.19.21 adjusting the C Start entry until CG 1030 is 4.60, +0.08 -0.08 vdc.
- 6.2.19.23 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- VERB 05, NOUN 31
  - R1=01102
- does not appear on DSKY.
- 6.2.19.23.1 Into R-154, insert 0101. Verify and execute.

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- 6.2.19.24 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted.   
 \* If CG 1020 at PSAAM is lighted instead of ONP.
- 6.2.19.25 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- a. ERROR RESET
  - b. VERB 21, NOUN 27, ENTER
  - c. 77777, ENTER.
- 6.2.19.26 Units R-154, insert 0001. Verify and execute.
- 6.2.19.27 Insert in C-156, -040001244 and execute. Verify on CRT that GV0116 is between -3.0 and -5.0 vdc.
- 6.2.19.28 Units R-154, insert 0111. Verify and execute.
- 6.2.19.29 Observe CG 1020, +14 VDC Power Supply on CRT. Repeat 6.2.19.26 through 6.2.19.28 adjusting the C Start entry until CG 1020 is 12.1, +0.1, -0.0 vdc.
- 6.2.19.30 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- a. VERB 05, NOUN 31
  - b. R1 = 01102
- does not appear on DSKY.
- 6.2.19.30.1 Into R-154, insert 0011. Verify and execute.
- 6.2.19.31 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted.   
 \* If CG 1020 at PSAAM is lighted instead of ONP.
- 6.2.19.32 Units R-154, insert 0000. Verify and execute.
- 6.2.19.33 Terminate CMC Self-Check by inserting into K-148:
- a. ERROR RESET
  - b. VERB 21, NOUN 27, ENTER
  - c. 00000, ENTER
- 6.2.19.34 Ensure that CG 1020, +14 VDC Power Supply indication is +14.0, ±0.4, and that CG 1030, +4 VDC Power Supply indication is +4.00±0.20 VDC on CRT.

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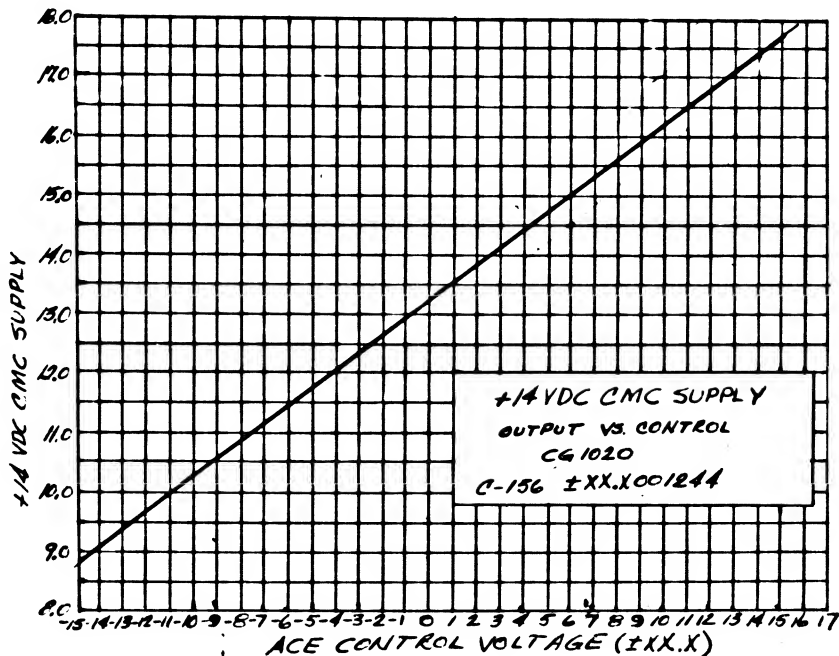
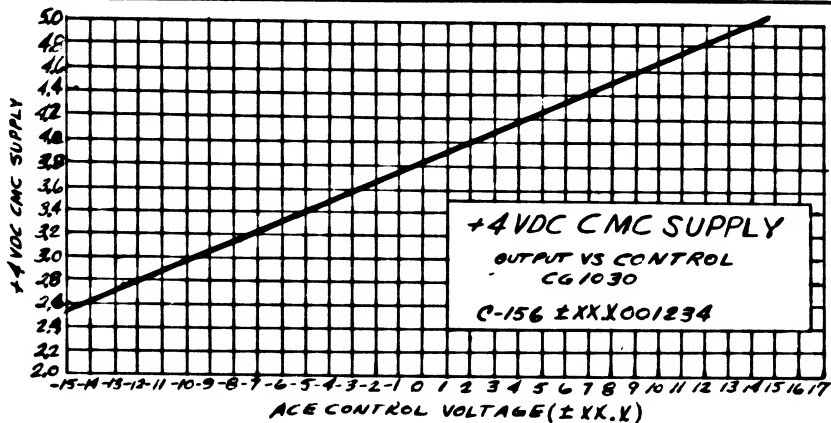


TABLE I

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**6.2.20 Spacecraft Control and Displays Test**

**6.2.20.1 Perform Master Initialization before proceeding with test operation**

**6.2.20.2 FDAI Attitude Error**

**6.2.20.2.1 Insert in K148**

- a. V 57 ENTER
- b. 00013 ENTER

**6.2.20.2.2 Observe on CRT**

- a. V 06 NO1 Flashing
- b. PROG 07
- c. NO ATT ON
- d. R1, R2, and R3 Approx. 00000

**6.2.20.2.3 Insert in K148**

- a. VERB 33, ENTER

**6.2.20.2.4 Observe on CRT**

- a. V 06 NO1 Flashing
- b. R1 +00385
- c. R2 -00385
- d. R3 +00385
- e. NO ATT OFF

**6.2.20.2.5 Record CRT indications**

- a. CG 2279 ROLL ATT ERROR - CDU DAC OUT +5.06±0.56 VRMS
- b. CG 2219 PITCH ATT ERROR - CDU DAC OUT -5.06±0.56 VRMS
- c. CG 2249 YAW ATT ERROR - CDU DAC OUT +5.06±0.56 VRMS

**6.2.20.2.6 Insert in K148**

- a. VERB 33, ENTER

**6.2.20.2.7 Observe on CRT**

- a. V 06 NO1 Flashing
- b. R1 +00384
- c. R2 -00384
- d. R3 +00384



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6.2.20.2.8 Record CRT indications

- |            |                               |                 |
|------------|-------------------------------|-----------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT  | +8.06±0.06 VRMS |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | -8.06±0.06 VRMS |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT   | +8.06±0.06 VRMS |

6.2.20.2.9 Insert in K148

- a. VERB 33, ENTER

6.2.20.2.10 Observe on CRT

- |         |     |          |
|---------|-----|----------|
| a. V 06 | NO1 | Flashing |
| b. R1   |     | +00160   |
| c. R2   |     | -00160   |
| d. R3   |     | +00160   |

6.2.20.2.11 Record CRT indications

- |            |                               |                 |
|------------|-------------------------------|-----------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT  | +8.11±0.27 VRMS |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | -8.11±0.27 VRMS |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT   | +8.11±0.27 VRMS |

6.2.20.2.12 Insert in K148

- a. VERB 33, ENTER

6.2.20.2.13 Observe on CRT

- |         |     |          |
|---------|-----|----------|
| a. V 06 | NO1 | Flashing |
| b. R1   |     | +00135   |
| c. R2   |     | -00135   |
| d. R3   |     | +00135   |

6.2.20.2.14 Record CRT indications

- |            |                               |                 |
|------------|-------------------------------|-----------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT  | +1.78±0.23 VRMS |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | -1.78±0.23 VRMS |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT   | +1.78±0.23 VRMS |

6.2.20.2.15 Insert in K148

- a. VERB 33, ENTER

6.2.20.2.16 Observe on CRT

- |         |     |          |
|---------|-----|----------|
| a. V 06 | NO1 | Flashing |
| b. R1   |     | +00090   |
| c. R2   |     | -00090   |
| d. R3   |     | +00090   |

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6.2.20.2.17 Record CRT indications

|            |                               |                               |
|------------|-------------------------------|-------------------------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT  | +1.19±0.18 VRMS <sub>es</sub> |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | -1.19±0.18 VRMS <sub>es</sub> |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT   | +1.19±0.18 VRMS <sub>es</sub> |

6.2.20.2.18 Insert in K148

a. VERB 33, ENTER

6.2.20.2.19 Observe on CRT

|         |     |          |
|---------|-----|----------|
| a. V 06 | N01 | Flashing |
| b. R1   |     | +00000   |
| c. R2   |     | +00000   |
| d. R3   |     | -00090   |

6.2.20.2.20 Record CRT indications

|            |                               |                               |
|------------|-------------------------------|-------------------------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT  | 0.00±0.05 VRMS <sub>es</sub>  |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | 0.00±0.05 VRMS <sub>es</sub>  |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT   | -1.19±0.18 VRMS <sub>es</sub> |

6.2.20.2.21 Insert in K148

a. VERB 33, ENTER

6.2.20.2.22 Observe on CRT

|         |     |          |
|---------|-----|----------|
| a. V 06 | N01 | Flashing |
| b. R1   |     | -00090   |
| c. R2   |     | +00090   |
| d. R3   |     | -00135   |

6.2.20.2.23 Record CRT indications

|            |                               |                               |
|------------|-------------------------------|-------------------------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT  | -1.19±0.18 VRMS <sub>es</sub> |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +1.19±0.18 VRMS <sub>es</sub> |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT   | -1.18±0.23 VRMS <sub>es</sub> |

6.2.20.2.24 Insert in K148

a. VERB 33, ENTER

6.2.20.2.25 Observe on CRT

|         |     |          |
|---------|-----|----------|
| a. V 06 | N01 | Flashing |
| b. R1   |     | -00135   |
| c. R2   |     | +00135   |
| d. R3   |     | -00160   |

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6.2.20.2.26 Record CRT indications

- |    |         |                               |                 |
|----|---------|-------------------------------|-----------------|
| a. | CG 2279 | ROLL ATT ERROR - CDU DAC OUT  | -1.78±0.23 VRMS |
| b. | CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +1.78±0.23 VRMS |
| c. | CG 2249 | YAW ATT ERROR - CDU DAC OUT   | -0.11±0.07 VRMS |

6.2.20.2.27 Insert in K148

- a. VERB 33, ENTER

6.2.20.2.28 Observe on CRT

- |    |      |     |          |
|----|------|-----|----------|
| a. | V 06 | NO1 | Flashing |
| b. | R1   |     | -00160   |
| c. | R2   |     | +00160   |
| d. | R3   |     | -00384   |

6.2.20.2.29 Record CRT indications

- |    |         |                               |                 |
|----|---------|-------------------------------|-----------------|
| a. | CG 2279 | ROLL ATT ERROR - CDU DAC OUT  | -2.11±0.37 VRMS |
| b. | CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +2.11±0.37 VRMS |
| c. | CG 2249 | YAW ATT ERROR - CDU DAC OUT   | -5.06±0.66 VRMS |

6.2.20.2.30 Insert in K148

- a. VERB 33, ENTER

6.2.20.2.31 Observe on CRT

- |    |      |     |          |
|----|------|-----|----------|
| a. | V 06 | NO1 | Flashing |
| b. | R1   |     | -00384   |
| c. | R2   |     | +00384   |
| d. | R3   |     | -00385   |

6.2.20.2.32 Record CRT indications

- |    |         |                               |                 |
|----|---------|-------------------------------|-----------------|
| a. | CG 2279 | ROLL ATT ERROR - CDU DAC OUT  | -5.06±0.66 VRMS |
| b. | CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +5.06±0.66 VRMS |
| c. | CG 2249 | YAW ATT ERROR - CDU DAC OUT   | -5.06±0.66 VRMS |

6.2.20.2.33 Insert in K148

- a. VERB 33, ENTER

6.2.20.2.34 Observe on CRT

- |    |      |     |          |
|----|------|-----|----------|
| a. | V 06 | NO1 | Flashing |
| b. | R1   |     | -00385   |
| c. | R2   |     | +00385   |
| d. | R3   |     | +00000   |

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6.2.20.2.35 Record CRT indications

|            |                               |                 |
|------------|-------------------------------|-----------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT  | -5.00±0.00 VRMS |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +5.00±0.00 VRMS |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT   | 0.00±0.00 VRMS  |

6.2.20.2.36 Insert in KL48

|          |     |       |
|----------|-----|-------|
| a. V 21  | NO1 | ENTER |
| b. 02545 |     | ENTER |
| c. 02637 |     | ENTER |
| d. V 33  |     | ENTER |

6.2.20.2.37 Observe on CRT

|           |     |                      |
|-----------|-----|----------------------|
| a. V 98   | MO2 | Flashing             |
| b. NO ATT |     | ON                   |
| c. R1     |     | +00000 approximately |
| d. R2     |     | +00000 approximately |
| e. R3     |     | +00000 approximately |

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6.2.20.3 TVC Test

6.2.20.3.1 The G/W Autopilot Control and SPS Ready discretes shall be applied to the G/W interface.

6.2.20.3.2 Set the OPTICS MODE selector on the Indicator Control panel to MAN. Set the OPTICS ZERO switch to OFF.

6.2.20.3.3 Insert in K148

a. VERB 33, ENTER

6.2.20.3.4 Observe on CRT

|         |      |          |
|---------|------|----------|
| a. V 01 | N 10 | Flashing |
| b. R1   |      | X7373    |
| c. R3   |      | 00030    |

6.2.20.3.5 Insert in K148

a. V 33 ENTER

6.2.20.3.6 Observe on CRT

|         |         |          |
|---------|---------|----------|
| a. V 01 | NOUN 10 | Flashing |
| b. R1   |         | 37777    |
| c. R3   |         | 00031    |

6.2.20.3.7 Insert in K148

a. V 33 ENTER

6.2.20.3.8 Observe on CRT

|         |      |          |
|---------|------|----------|
| a. V 06 | N 02 | Flashing |
| b. R1   |      | +00385   |
| c. R2   |      | -00385   |
| d. R3   |      | +00003   |

6.2.20.3.9 Record CRT indications

|            |                         |                        |
|------------|-------------------------|------------------------|
| a. CG 3722 | TRUNNION CDU DAC OUTPUT | +16.00-18.12±1.00 VRMS |
| b. CG 3721 | SHAFT CDU DAC OUTPUT    | -16.00-18.12±1.00 VRMS |

6.2.20.3.10 Insert in K148

a. VERB 33, ENTER

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6.2.20.3.11 Observe on CRT

|           |      |          |
|-----------|------|----------|
| a. V 06   | N 03 | Flashing |
| b. R1     |      | +00384   |
| c. R2     |      | -00384   |
| d. R3     |      | +00003   |
| e. NO ATT |      | OFF      |

6.2.20.3.12 Record CRT indications

|            |                         |                  |
|------------|-------------------------|------------------|
| a. CG 3722 | TRUNNION CDU DAC OUTPUT | +10.12±1.00 VRMS |
| b. CG 3721 | SHAFT CDU DAC OUTPUT    | -10.12±1.00 VRMS |

6.2.20.3.13 Insert in K148

a. VERB 33, ENTER

6.2.20.3.14 Observe on CRT

|         |      |          |
|---------|------|----------|
| a. V 06 | N 03 | Flashing |
| b. R1   |      | +00160   |
| c. R2   |      | -00160   |
| d. R3   |      | +00003   |

6.2.20.3.15 Record CRT indications

|            |                         |                 |
|------------|-------------------------|-----------------|
| a. CG 3722 | TRUNNION CDU DAC OUTPUT | +4.22±0.42 VRMS |
| b. CG 3721 | SHAFT CDU DAC OUTPUT    | -4.22±0.42 VRMS |

6.2.20.3.16 Insert in K148

a. VERB 33, ENTER

6.2.20.3.17 Observe on CRT

|         |      |          |
|---------|------|----------|
| a. V 06 | N 03 | Flashing |
| b. R1   |      | +00135   |
| c. R2   |      | -00135   |
| d. R3   |      | +00003   |

6.2.20.3.18 Record CRT indications

|            |                         |                 |
|------------|-------------------------|-----------------|
| a. CG 3722 | TRUNNION CDU DAC OUTPUT | +3.56±0.36 VRMS |
| b. CG 3721 | SHAFT CDU DAC OUTPUT    | -3.56±0.36 VRMS |

6.2.20.3.19 Insert in K148

a. VERB 33, ENTER

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6.2.20.3.20 Observe on CRT

|         |      |          |
|---------|------|----------|
| a. V 06 | N 02 | Flashing |
| b. R1   |      | +00090   |
| c. R2   |      | -00090   |
| d. R3   |      | +00003   |

6.2.20.3.21 Record CRT indications

|            |                         |                 |
|------------|-------------------------|-----------------|
| a. CG 3722 | TRUNNION CDU DAC OUTPUT | -2.38±0.24 VRMS |
| b. CG 3721 | SHAFT CDU DAC OUTPUT    | -2.38±0.24 VRMS |

6.2.20.3.22 Set the OPTICS SPEED Switch on the Indicator Control Panel to HI.

6.2.20.3.23 Insert in K148

a. VERB 33, ENTER

6.2.20.3.24 Observe on CRT

|         |      |          |
|---------|------|----------|
| a. V 06 | N 02 | Flashing |
| b. R1   |      | +00000   |
| c. R2   |      | +00000   |
| d. R3   |      | +00003   |

6.2.20.3.25 While holding the Optics Hand Controller up and left (45°) no longer than 10 seconds, record CRT indications.

|            |                         |                |
|------------|-------------------------|----------------|
| a. CG 3722 | TRUNNION CDU DAC OUTPUT | 0.00±0.12 VRMS |
| b. CG 3721 | SHAFT CDU DAC OUTPUT    | 0.00±0.12 VRMS |

6.2.20.3.26 Insert in K148

a. VERB 33, ENTER

6.2.20.3.27 Observe on CRT

|         |      |          |
|---------|------|----------|
| a. V 06 | N 02 | Flashing |
| b. R1   |      | -00090   |
| c. R2   |      | +00090   |
| d. R3   |      | +00003   |

6.2.20.3.28 Record CRT indications

|            |                         |                 |
|------------|-------------------------|-----------------|
| a. CG 3722 | TRUNNION CDU DAC OUTPUT | -2.38±0.24 VRMS |
| b. CG 3721 | SHAFT CDU DAC OUTPUT    | +2.38±0.24 VRMS |

- 6.2.20.3.29      Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the Indicator Control Panel to ZERO for 30 seconds, then return to OFF.
- 6.2.20.3.30      Insert in K148
- a. VERB 33,      ENTER
- 6.2.20.3.31      Observe on CRT
- a. V 06      N 02      Flashing  
                 b. R1                   -00135  
                 c. R2                   +00135  
                 d. R3                   +00003
- 6.2.20.3.32      Record CRT indications
- a. CG 3722 TRUNNION CDU DAC OUTPUT      -3.56±0.36 VRMS  
                 b. CG 3721 SHAFT CDU DAC OUTPUT      +3.56±0.36 VRMS
- 6.2.20.3.33      Insert in K148
- a. VERB 33,      ENTER
- 6.2.20.3.34      Observe on CRT
- a. V 06      N 02      Flashing  
                 b. R1                   -00160  
                 c. R2                   +00160  
                 d. R3                   +00003
- 6.2.20.3.35      Record CRT indications
- a. CG 3722 TRUNNION CDU DAC OUTPUT      -4.22±0.42 VRMS  
                 b. CG 3721 SHAFT CDU DAC OUTPUT      +4.22±0.42 VRMS
- 6.2.20.3.36      Insert in K148
- a. VERB 33,      ENTER
- 6.2.20.3.37      Observe on CRT
- a. V 06      N 02      Flashing  
                 b. R1                   -00384  
                 c. R2                   +00384  
                 d. R3                   +00003



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6.2.20.3.38 Record CRT indications

- a. CG 3722 TRUNNION CDU DAC OUTPUT  $-10.12 \pm 1.00$  VRMS
- b. CG 3721 SHAFT CDU DAC OUTPUT  $+10.12 \pm 1.00$  VRMS

6.2.20.3.39 Insert in K148

- a. VERB 33, ENTER

6.2.20.3.40 Observe on CRT

- a. V 00 N 02 Flashing
- b. R1 -00385
- c. R2 +00385
- d. R3 +00003

6.2.20.3.41 Record CRT indications

- a. CG 3722 TRUNNION CDU DAC OUTPUT  $-10.12 \pm 1.00$  VRMS
- b. CG 3721 SHAFT CDU DAC OUTPUT  $+10.12 \pm 1.00$  VRMS

6.2.20.3.42 Insert in K148

- a. V 34 ENTER
- b. V 40 N 20 ENTER
- c. V 41 N 20 ENTER
- d. +00000 ENTER
- e. +00000 ENTER
- f. +00000 ENTER

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## APPENDIX I

| <u>Signal</u> | <u>Link</u> | <u>Nomenclature</u>             | <u>G&amp;N Test Requirement</u>              | <u>PSAAM and/or SCA Uncertainty % of Full Scale</u> |
|---------------|-------------|---------------------------------|----------------------------------------------|-----------------------------------------------------|
| CG 1020       | 1           | +14 VDC CMC SUPPLY              | +14.0 ± 0.4 VDC                              | 0%                                                  |
| CG 1030       | 1           | +4 VDC CMC SUPPLY               | +4.00 ± 0.2 VDC                              | 0%                                                  |
| CG 1040       | 2           | +120 VDC PIPA SUPPLY            | +120 ± 6.0 VDC                               | 1%                                                  |
| CG 1051       | 1           | +20 VDC PIPA SUPPLY             | +20.0 ± 1.2 VDC                              | 0%                                                  |
| CG 1052       | 1           | -20 VDC PIPA SUPPLY             | -20 ± 2 VDC                                  | 0%                                                  |
| CG 1070       | 1           | +4 VDC CDU SUPPLY               | +4.0 ± 0.2 VDC                               | 0%                                                  |
| CG 1100       | 1           | -28 VDC SUPPLY                  | -27.5 ± 6.0 VDC                              | 0%                                                  |
| CG 1110       | 2           | 2.5 VDC TM BIAS                 | +2.50±0.08 VDC                               | 0%                                                  |
| CG 1201       | 2           | IMU 28V .8KC 1% 0° RMS          | 28.00 ± 0.56 VRMS                            | 1%                                                  |
| CG 1202       | 1           | IMU 28V .8 KC 5% - 90° RMS      | 28.0 ± 1.4 VRMS                              | 0.33%                                               |
| CG 1203       | 1           | IMU 28V .8KC 0° RMS             | 28.0 ± 2.1 VRMS                              | 0.33%                                               |
| CG 1207       | 1           | PH DIFF OPTV 5% 0° -90°         | -90±10°                                      | 2.3%                                                |
| CG 1211       | 1           | OPTX 28V .8KC 1% 0° RMS         | 28.00 ± 0.56 VRMS                            | 0.33%                                               |
| CG 1212       | 1           | OPTX 28V .8KC 5% -90° RMS       | 28.00 ± 1.48 VRMS                            | 0.33%                                               |
| CG 1220       | 1           | PH DIFF OPTV 1% IMU 1%          | 0° ± 10°                                     | 2.3%                                                |
| CG 1331       | 2           | 3.2 KC 28V SUPPLY               | 28.6 ± 0.56 VRMS                             | 1%                                                  |
| CG 1336       | 1           | PH DIFF 3.2 KC 28V/CMC SYNC     | 0° ± 10°                                     | 2.3%                                                |
| CG 1500       | 1           | +28 VDC IMU OPERATE BUS         | 28.8 ± 3VDC                                  | 0%                                                  |
| CG 1510       | 1           | +28 VDC IMU STANDBY BUS         | 28.8 ± 3 VDC                                 | 0%                                                  |
| CG 1520       | 1           | +28 VDC CMC OPERATE BUS         | 28.8 ± 3 VDC                                 | 0%                                                  |
| CG 1530       | 1           | +28 VDC OPTX OPERATE BUS        | 28.8 ± 3 VDC                                 | 0%                                                  |
| CG 2001       | 2           | X PIPA SG O/P                   | 5 VRMS max                                   | 3%                                                  |
| CG 2021       | 2           | Y PIPA SG O/P                   | 5 VRMS max                                   | 9.23%                                               |
| CG 2041       | 2           | Z PIPA SG O/P                   | 5 VRMS max                                   | 3%                                                  |
| CG 2108       | 1           | IG SERVO ERROR QUAD             | 0.0 ± 1.2 VRMS                               | 3.6%                                                |
| CG 2112       | 2           | IG LX RESOLVER O/P SIN          | 18.38 ± 1.84 VRMS @ 45°                      | 2.5%                                                |
| CG 2113       | 2           | IG LX RESOLVER O/P COS          | 18.38±1.84 VRMS @ 45°                        | 2.5%                                                |
| CG 2117       | 2           | IG SERVO ERROR IN PHASE         | 0.0 ± 60mv RMS @ null                        | 1.4%                                                |
| CG 2120       | 1           | IG TORQUE MOTOR CURRENT         | 0.125 amp max during Fine Alignment Torquing | 0%                                                  |
| CG 2138       | 1           | MG SERVO ERROR QUAD             | 0.0 ± 1.2 VRMS                               | 3.6%                                                |
| CG 2142       | 2           | MG LX RESOLVER O/P SIN          | 18.38±1.84 VRMS @45°                         | 2.5%                                                |
| CG 2143       | 2           | MG LX RESOLVER O/P COS          | 18.38±1.84 VRMS @45°                         | 2.5%                                                |
| CG 2147       | 2           | MG SERVO ERROR IN PHASE         | 0.0 ± 60 mv rms @ null                       | 1.4%                                                |
| CG 2150       | 1           | MG TORQUE MOTOR CURRENT         | 0.125 amp max during Fine Align Torquing     | 0%                                                  |
| CG 2168       | 1           | OG SERVO ERROR QUAD             | 0.0 ± 1.2 VRMS                               | 3.6%                                                |
| CG 2172       | 2           | OG LX RESOLVER O/P SIN          | 18.38±1.84 VRMS @45°                         | 2.5%                                                |
| CG 2173       | 2           | OG LX RESOLVER O/P COS          | 18.38±1.84 VRMS @45°                         | 2.5%                                                |
| CG 2177       | 2           | OG SERVO ERROR IN PHASE         | 0.0 ± 60mvRMS @ null                         | 1.4%                                                |
| CG 2180       | 1           | OG TORQUE MOTOR CURRENT         | 0.125 amp max during Fine Align Torquing     | 0%                                                  |
| CG1042        | 1           | +120 VDC PIPA SUP NOISE RMS     | 1.5 VRMS MAX                                 | 0%                                                  |
| CG1053        | 1           | +20 VDC PIPA SUP NOISE RMS      | 1.0 VRMS MAX                                 | 0%                                                  |
| CG1071        | 1           | +4 VDC CDU SUP NOISE RMS        | 0.10 VRMS MAX                                | 0%                                                  |
| CG1501        | 1           | +28V IMU OPERATE BUS NOISE RMS  | 1.0 VRMS MAX                                 | 0%                                                  |
| CG1511        | 1           | +28V IMU STANDBY BUS NOISE RMS  | 1.0 VRMS MAX                                 | 0%                                                  |
| CG1521        | 1           | +28V CMC OPERATE BUS NOISE RMS  | 2.0 VRMS MAX                                 | 0%                                                  |
| CG1531        | 1           | +28V OPTX OPERATE BUS NOISE RMS | 2.0 VRMS MAX                                 | 0%                                                  |

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| Signal  | Link | Nomenclature                      | G&N Test Requirement         | PSAAM and/or SCA Uncertainty % of Full Scale |
|---------|------|-----------------------------------|------------------------------|----------------------------------------------|
| CG 2219 | 1    | PITCH ATT ERROR - CDU DAC O/P     | 5.06 ± 0.5 VRMS @ 17°        | 0.67%                                        |
| CG 2220 | 1    | IG CDU FINE ERROR                 | 0.0 ± 0.07VRMS @ null        | 0.29%                                        |
| CG 2221 | 1    | IG CDU COARSE ERROR               | 0.0 ± 0.68 VRMS @ null       | 0.29%                                        |
| CG 2249 | 1    | YAW ATT ERROR-CDU DAC O/P         | 5.06 ± 0.5VRMS @ 17°         | 0.67%                                        |
| CG 2250 | 1    | MG CDU FINE ERROR                 | 0.0 ± 0.07VRMS @ null        | 0.29%                                        |
| CG 2251 | 1    | MG CDU COARSE ERROR               | 0.0 ± 0.68VRMS @ null        | 0.29%                                        |
| CG 2279 | 1    | ROLL ATT ERROR-CDU DAC O/P        | 5.06 ± 0.5VRMS @ 17°         | 0.67%                                        |
| CG 2280 | 1    | OG CDU FINE ERROR                 | 0.0 ± 0.07 VRMS 2 null       | 0.29%                                        |
| CG 2281 | 1    | OG CDU COARSE ERROR               | 0.0 ± 0.68 VRMS              | 0.29%                                        |
| CG 2300 | 1    | PIPA TEMPERATURE                  | 130.5±1.5°F Operate Mode     | 2%                                           |
| CG 3011 | 2    | TRUNNION CDU FINE ERROR           | 0.0 ± 0.07VRMS @ null        | 0.29%                                        |
| CG 3021 | 2    | SHAFT CDU FINE ERROR              | 0.0 ± 0.07VRMS @ null        | 0.29%                                        |
| CG 3117 | 1    | SXT SHAFT SERVO ERROR IN PH       | 2 VRMS max                   | 1.1%                                         |
| CG 3118 | 1    | SXT TRUNNION SERVO ERROR IN PHASE | 2 VRMS max                   | 1.1%                                         |
| CG 3140 | 1    | SXT SHAFT TACH O/P                | 2.3 ± 1.3VRMS @ HI Rate      | 1.1%                                         |
| CG 3145 | 1    | SXT SHAFT MTR CONTROL WINDING     | +0.50 to +4.00 VRMS Mod Rate | 1.1%                                         |
| CG 3150 | 2    | SXT TRUNNION TACH O/P             | 3.3 ± 1.3VRMS @ HI Rate      | 1.1%                                         |
| CG 3155 | 1    | SXT TRUNNION MTR CONTROL WINDING  | +0.25 to +2.00 VRMS Mod Rate | 1.1%                                         |
| CG 3160 | 1    | SCT SHAFT TACH O/P                | 3.3 ± 1.3 VRMS @ HI Rate     | 1.1%                                         |
| CG 3170 | 1    | SCT TRUNNION TACH O/P             | 0.85 ± 0.35VRMS @ HI Rate    | 1.1%                                         |
| CG 3721 | 1    | SHAFT CDU DAC O/P                 | 10.12±1.00 VRMS @ 17°        | 1%                                           |
| CG 3722 | 2    | TRUNNION CDU DAC O/P              | 10.12±1.00 VRMS @ 17°        | 1%                                           |
| CG 4300 | 2    | CMC TEMP                          | 87.5±42.5°F                  | 0.23%                                        |
| CG 6020 | 1    | PIPA CAL MODULE TEMP              | 72.5±27.5°F                  | 0.23%                                        |
| CG 6021 | 1    | IMU 800 cps 5% TEMP (PSA)         | 90±20°F                      | 0%                                           |
| CG 2301 | 1    | IRIG TEMPERATURE                  | 130 ± 2.5°F in Operate       | 2%                                           |
| CG 1021 | 1    | +14V CMC SUPPLY NOISE RMS         | 0.2 VRMS max                 | 0%                                           |
| CG 1031 | 1    | +4 CMC SUPPLY NOISE RMS           | 0.2 VRMS max                 | 0%                                           |

PSAAM OUTPUT is the source of Link 1 signals

SCA OUTPUT is the source of Link 2 signals.

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# ADDENDUM I

**SCOPE:** The following changes are required to make ND1002325 applicable as G&N System technical support documentation for CSM 101.

**Addition 1.** Add paragraph 6.1.1.7 as follows:

**6.1.1.7** Data from the on-board tape recorder shall be made available and the following signals verified:

- a. IG TORQUE MOTOR CURRENT (CG 2120) shall be less than 0.125 amp max.
- b. OG TORQUE MOTOR CURRENT (CG 2180) shall be less than 0.125 amp max.
- c. MG TORQUE MOTOR CURRENT (CG 2150) shall be less than 0.125 amp max.

**Addition 2.** Paragraph 6.2.1.5.6, change the last sentence to read as follows:

On the Event Recorder verify that the IMU HTR Current switch discrete (CG 2302 Link 2) is on and that the IMU Blower Current discrete (CG 2303 Link 2) is OFF over the last 2 hour period (occasionally discretizes may cycle).

**Addition 3.** Add paragraph 6.2.4.6.1 as follows:

**6.2.4.6.1** On the analog recorder verify that (CG 1211 Link 2, OPTICS 28V 800 cps 1% 0 deg) RMS voltage is  $28.0 \pm 0.06$  VAC.

**Addition 4.** Add Paragraph 6.2.20.2.5.1 and 6.2.20.2.32.1 as follows:

**6.2.20.2.5.1** Verify on the analog recorder the following signals:

- a. CG 2279 Link 2 ROLL ATT ERROR - CDU DAC OUT  $+5.06 \pm 0.66$  VRMS
- b. CM 2219 Link 2 PITCH ATT ERROR - CDU DAC OUT  $-5.06 \pm 0.66$  VRMS
- c. CG 2249 Link 2 YAW ATT ERROR - CDU DAC OUT  $+5.06 \pm 0.66$  VRMS

**6.2.20.2.32.1** Verify on the analog recorder the following signals:

- a. CG 2279 Link 2 ROLL ATT ERROR - CDU DAC OUT  $-5.06 \pm 0.66$  VRMS
- b. CG 2219 Link 2 PITCH ATT ERROR - CDU DAC OUT  $+5.06 \pm 0.66$  VRMS
- c. CG 2249 Link 2 YAW ATT ERROR - CDU DAC OUT  $-5.06 \pm 0.66$  VRMS

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Addition 5. Paragraph 6.1.2.1., add new Paragraph 6.1.2.1.5 as follows:

6.1.2.1.5 Data from the on-board tape recorder shall be made available and the following signals verified.

- a. VIB NB ROLL (CG 6001)
- b. VIB NB PITCH (CG 6002)
- c. VIB NB YAW (CG 6003)

Addition 6. Replace Paragraph 6.2.3.1.13 with the following:

6.2.3.1.13 30 minutes after switching from Standby mode to the Operate mode record the IRIG temperature. The recorded IRIG temperature shall be within 0.5 deg F. of the Operate stabilized IRIG temperature determined below.

Add the following sentence to Paragraph 6.2.3.1.14:

Record the Operate mode stabilized IRIG temperature. The Operate mode stabilized IRIG temperature shall be 135±2.5° F.

Paragraph 6.2.5.2.16, add the following to Table VI:

14 CG 2301 IRIG TEMPERATURE

Addition 7. Paragraph 6.1.1.6, add item "f" as follows:

- f. The TRACKER switch on G&N Indicator Control Panel shall be set to OFF.

Addition 8. Replace Paragraph 6.2.3.1.2 with the following:

6.2.3.1.2 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Switch and selectors on the G&N Indicator Control Panel shall be set as follows.

- a. OPTICS MODE to ZERO SLIP
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to MED
- d. TELESCOPE TRUNNION to SLAVE to SXT
- e. RETICLE BRIGHTNESS to minimum brightness position

Addition 9. Replace Paragraph 6.2.5.1.2 with the following:

6.2.5.1.2 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the

following switches on the G&N Indicator Control Panel to the positions designated.

- a. OPTICS MODE to ZERO
- b. CONTROLLER MODE to DIRECT
- c. CONTROLLER SPEED to LO
- d. TELESCOPE TRUNNION to SLAVE to SXT
- e. RETICLE BRIGHTNESS to minimum brightness position

Addition 10. Replace Paragraph 6.2.5.2.1 with the following:

6.2.5.2.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set or verify the following G&N Indicator Control Panel switches to the position indicated.

- a. CONDITION LAMPS to ON
- b. OPTICS MODE to ZERO
- c. CONTROLLER COUPLING to DIRECT
- d. CONTROLLER SPEED to LO
- e. TELESCOPE TRUNNION to SLAVE to SXT
- f. RETICLE BRIGHTNESS to minimum brightness position

Addition 11. Replace Paragraph 6.2.5.3.6 with the following:

6.2.5.3.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Insure that the following switches are set to the positions indicated:

- a. CONTROLLER COUPLING to DIRECT
- b. OPTICS MODE to ZERO
- c. TELESCOPE TRUNNION to SLAVE to SXT
- d. TRACKER to OFF
- e. CONTROLLER SPEED to LO
- f. CONDITION LAMPS to ON
- g. UP TELEMETRY to ACCEPT

Addition 12. Replace Paragraph 6.2.9.23 with the following:

6.2.9.23 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to CMC.

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Addition 13. Replace Sections 6.2.10 through 6.2.13 with the following:

**6.2.10 Zero Optics Test**

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2 Turn On Procedure before proceeding.

**INITIALIZATION**

**6.2.10.1** Set the G/N POWER - OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

**6.2.10.2** Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.

- a. VERB 41, NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

**6.2.10.3** Insure that the following switches on the G&N Indicator Control Panel are set as follows:

- a. TELESCOPE TRUNNION to SLAVE to SXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to HI

**OPTICS ZERO MODE TEST**

**6.2.10.4** Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K-148. Press the ENTER pushbutton.

**6.2.10.5** Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds; Verify the Optics have zeroed properly by observing the following on R1 and R2 of the DSKY.

- a. R1 = +0.00° +0.02° , -0.03° (Shaft Angle)
- b. R2 = +0.000° +0.006° , -0.007° (Trunnion LOS Angle)

6.2.10.5.1 Enter the following

VERB 01 NOUN 10, ENTER  
00033, ENTER  
Verify R1 = XXX6X

6.2.10.5.2 Set the OPTICS MODE switch to CMC. Enter the following:

ENTER  
00033, ENTER  
Verify R1 = XXX5X

6.2.10.5.3 Set the OPTICS MODE switch to MAN. Press the KEY REL pushbutton on the DSKY.

OPTICS BACKUP MODE TEST

6.2.10.6 Insert the Inflight Tool (V36601405) into the Trunnion Tool input and engage drive mechanism (button out). Verify that the trunnion turns by viewing the movement through the SCT eyepiece while turning the tool until the TPAC reads +6 deg. Remove the tool from the trunnion tool input.

6.2.10.7 Insert the Inflight Tool (V36601405) into the Shaft Tool input and engage the drive mechanism (button out). Verify that the Shaft turns by viewing the movement through the SCT eyepiece while turning the tool so that the shaft moves through an angle from 0° to +3 to -3 to 0 as indicated on the shaft TPAC. Disengage the shaft drive mechanism (button in) and remove the tool.



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- 6.2.10.8 Insert the Inflight Tool (V36601405) into the Trunnion Tool Input. Verify that the Trunnion Turns by viewing the movement through the SCT eyepiece while turning the tool so that the trunnion moves from +5° to -5° and back to zero as indicated on the Trunnion TPAC. Disengage the trunnion drive mechanism (button in) and remove the tool.
- 6.2.11 Optics Coordinate Transformation Control Test
- NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure before proceeding.
- INITIALIZATION
- 6.2.11.1 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE B4 8 (CG 1530) is +28.0±3 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.
- 6.2.11.2 Enter the following into the K-Start. Press the ENTER pushbutton after each entry:
- VERB 41 NOUN 20, ENTER
  - +00000, ENTER
  - +00000, ENTER
  - +00000, ENTER
- 6.2.11.3 Verify and/or set the following switches on the G&N Indicator control panel to the position indicated.
- TELESCOPE TRUNNION to SLAVE to SXT
  - CONTROLLER COUPLING to DIRECT
  - CONTROLLER SPEED to HI
- 6.2.11.4 Set up the analog recorders to monitor the following measurements.
- CG 3170 SCT Trunnion Tachometer Output
- 6.2.11.5 Enter the following into the K-Start to monitor the OPTICS CDU's.
- VERB 16 NOUN 55, press ENTER

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| 6.2.11.6                                    | Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within $\pm 5$ degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the G&N Panel to ZERO. Wait 15 seconds. Return the OPTICS MODE switch to MAN.                                                                                                                                                |  |  |  |  |  |      |
| RESOLVED MODE PHASING AND IMAGE RATE TEST   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |  |  |  |  |      |
| 6.2.11.7                                    | Using the Optics Control Stick, drive the Optics until $R1 = +225.00$ and $R2 = +10.000$ on the CRT and the DSKY's.                                                                                                                                                                                                                                                                                                                                                        |  |  |  |  |  |      |
| 6.2.11.8                                    | Set the CONTROLLER COUPLING switch on the G&N Panel to RSLV and CONTROLLER SPEED switch to MED.                                                                                                                                                                                                                                                                                                                                                                            |  |  |  |  |  |      |
| 6.2.11.9                                    | Position the movable optics target such that it is centered on the SCT reticle pattern, then start the analog recorders at a chart speed of 10 mm/second.                                                                                                                                                                                                                                                                                                                  |  |  |  |  |  |      |
| 6.2.11.10                                   | Quickly displace the Optics Control Stick $45 \pm 10$ degrees in the upper right hand quadrant while sighting on the optics target through the SCT eyepiece. The target shall appear to move in the upper right field of view of the SCT at $45 \pm 10$ deg. When target leaves the SCT upper right field of view press MARK pushbutton and immediately record the shaft angle as displayed on R1 of the DSKY. The recorded shaft angle shall be $+225 \pm 10.00$ degrees. |  |  |  |  |  |      |
| 6.2.11.11                                   | Stop the analog recorder and measure the elapsed time between the initial and the final signal null conditions for the Trunnion measurement. The elapsed time shall be $+19$ to $+32$ seconds.                                                                                                                                                                                                                                                                             |  |  |  |  |  |      |
| CSM AMPLIFIER SHAFT AND TRUNNION DRIVE TEST |                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |  |  |  |  |      |
| 6.2.11.12                                   | Set the CONTROLLER COUPLING switch to DIRECT. Again using the Optics Control Stick, drive the optics until $R1 = +225.00$ and $R2 = +10.000$ . Set the CONTROLLER COUPLING switch to RSLV.                                                                                                                                                                                                                                                                                 |  |  |  |  |  |      |
| 6.2.11.13                                   | While sighting on the optical target through the SCT eyepiece, displace the Optics Control Stick fully to the right. Verify that the target image appears to move in a straight line horizontally to the right and release the Optics Control Stick when the target image reaches the edge of the SCT field of view.                                                                                                                                                       |  |  |  |  |  |      |
| 6.2.11.14                                   | Enter VERB 34 in the DSKY. Press the ENTER pushbutton.                                                                                                                                                                                                                                                                                                                                                                                                                     |  |  |  |  |  |      |

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- 6.2.11.15** Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within  $\pm 6$  degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the CONTROLLER COUPLING switch on the G&N Panel to DIRECT. Set the OPTICS MODE switch to ZERO. After 15 seconds, return the switch to MAN.
- NOTE:** If optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.
- 6.2.12** Optics Functional Test
- Proceed with this test if 6.2.3 Operate Power On Test, or 6.2.5.2 Turn-on Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding.
- NOTE:** This test requires the use of the G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT StLOS before proceeding. Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.
- 6.2.12.1** Set/verify the G/N POWER OPTICS switch on the LEB Lighting Control Panel to OPTICS. Set TRACKER switch to OFF. Verify the following:
- +28 VDC OPTX OPERATE BUS (CG 1530) is 28.8±3 VDC. Record the indication on the CRT.
  - CG 1211 OPTX 28V 800 cps 1% 0 ph not flashing on CRT.
  - CG 1212 OPTX 800 cps 5% -90 ph not flashing on CRT.
- 6.2.12.2** Enter the following sequence into the K-Start.
- VERB 41, NOUN 20, ENTER
  - +00000, ENTER
  - +00000, ENTER
  - +00000, ENTER
- 6.2.12.3** Insure that the optics control switches on the G&N Indicator Control Panel are set as follows:
- OPTICS MODE to MAN
  - CONTROLLER SPEED to LO
  - CONTROLLER COUPLING to DIRECT
  - TELESCOPE TRUNNION to SLAVE to SXT

- 6.2.12.4 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees to zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN.
- 6.2.12.5 Resolution Checks
- 6.2.12.5.1 Sight through the SXT eyepiece. Using the Optic Control Stick, adjust the SXT to obtain the best reflected field of view of the 5-inch autocollimator reticle engraving at the center of the field of view.
- 6.2.12.5.2 Note that the autocollimator reticle contains a series of lines of different thickness and width. Each set of lines is marked with a number (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines. The SXT resolution shall be at least 10 arc-seconds at the center of the field of view.
- 6.2.12.5.3 Repeat 6.2.12.5.1 and 6.2.12.5.2 using the SCT and the SCT resolution chart. The SCT shall have a resolution of at least 3 arc-minutes at the center of the field of view.
- 6.2.12.6 Slave Telescope Mode Checks
- 6.2.12.6.1 Enter VERB 16 NOUN 55 into the K-Start, press the ENTER pushbutton.
- 6.2.12.6.2 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the Control Indicator Panel to ZERO. Wait 15 seconds.
- 6.2.12.6.3 Record the SCT Shaft and Trunnion angles as indicated by the TPAC and the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between the TPAC shaft angle and the Shaft CDU angle shall be  $\pm 0.11$  deg or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be  $\pm 0.22$  deg or less.

- 6.2.12.6.4 Place the OPTICS MODE switch to MAN. Using the Optics Control Stick drive the SXT Shaft and Trunnion CDU's until  $R1 = 035.000 \pm 0.10$  deg and  $R2 = +35.000 \pm 0.100$  deg, setting the CONTROLLER SPEED switch to LO as the angles are approached. Press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles as indicated by the TPAC. Record  $R1$  and  $R2$ . The difference between the TPAC Shaft angle and Shaft CDU angle shall be  $\pm 0.11$  deg or less. The difference between the TPAC Trunnion angle and Trunnion CDU angle shall be  $\pm 0.22$  deg or less.
- 6.2.12.6.5 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within  $\pm 5$  degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO.
- 6.2.12.6.6 Set the TELESCOPE TRUNNION switch to SLAVE to SXT position.
- 6.2.12.6.7 Remove the plug from the base of the SXT eyepiece and install the Adapter Assembly and Portable Light Assembly. Turn on the light.
- NOTE: If needed to reduce external light, place a photographer hood over the optics head and retroreflecting prism.
- 6.2.12.6.8 Sight through the SCT eyepiece and provide direction to personnel outside spacecraft for positioning the Retroreflecting Prism, Model No. A23-200, to span between the SXT LLOS and SCT LOS such that the illumination from the back-light filament is clearly visible at the center of the field of view. Prism must be held in this alignment position until completion of step 6.2.12.6.11.
- 6.2.12.6.9 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Note the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement, expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. For instance, the outer ends of the SXT reticle lines are 6% from center. Displacement shall be less than 50% (bar must be closer to center than to edge of field of view).
- 6.2.12.6.10 Set the TELESCOPE TRUNNION switch to 0° position.
- 6.2.12.6.11 Again direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in Step 6.2.12.6.9. Place the OPTICS MODE switch to MAN and observe the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement, expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. Displacement shall be less than 50%.
- 6.2.12.6.12 Remove the Retroreflecting Prism.

- 6.2.12.6.13 Replace the Portable Light in the adapter on the EXT eyepiece.
- 6.2.12.6.14 While sighting into the SCT eyepiece, set the TELESCOPE TRUNNION switch to 25° and observe that the resolution pattern mounted outside the spacecraft appears to move downward from the center of the field of view to the zero reticle marking that is 25° below the center of the field of view.
- 6.2.12.6.15 Record the TPAC Trunnion Angle. It shall be 25.00±0.22 deg.
- 6.2.12.6.16 Set the TELESCOPE TRUNNION switch to SLAVE to EXT.
- 6.2.12.7 EXT Parallelism Tests
- 6.2.12.7.1 Using the Optics Control Stick drive the EXT SLOS Trunnion to +15.000° ±5° as indicated in R2 of the DSKY. Maintain a Shaft CDU angle of 000.00 ±0.10 degrees as indicated by R1 of the DSKY.
- 6.2.12.7.2 Sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to superimpose the EXT LLOS horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.
- 6.2.12.7.3 Repeat 6.2.12.7.2 twice. Calculate and record the average of the three autocollimator readings.
- 6.2.12.7.4 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the EXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to EXT). Set the OPTICS MODE switch to ZERO.
- 6.2.12.7.5 Again sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to bring the EXT SLOS horizontal reticle and autocollimator horizontal filar images to coincide. Record the autocollimator reading.
- 6.2.12.7.6 Repeat 6.2.12.7.5 twice. Calculate and record the average of the three autocollimator readings. The average value obtained here shall not differ from that obtained in 6.2.12.7.3 by more than 10 arc-seconds.
- 6.2.12.7.7 Set the OPTICS MODE switch to MAN. Using the Optics Control Stick drive the EXT Trunnion angle to 85.00±5 degrees as indicated on R2 of the DSKY. Set the CONTROLLER SPEED switch to LO and drive the EXT Trunnion to +90.000 degrees ±0.100 degree as indicated on R2 of the DSKY. Insure that the EXT Shaft angle remains at 000.00±0.10 degree as indicated by R1 on the DSKY.
- 6.2.12.7.8 Sight through the EXT. Two reticle patterns shall be visible. Use the Optics Control Stick to adjust the EXT Trunnion angle until the two horizontal reticle lines are coincident. Record the Trunnion CDU angle displayed in R2. The Trunnion CDU angle shall be 90.000±0.10 degrees.
- 6.2.12.7.9 Remove the Portable Light Assembly and Adapter Assembly from the base of the EXT eyepiece. Replace the EXT eyepiece plug.

NOTE: If optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

- 6.2.12.8 Shaft and Trunnion Positional Accuracy Checks
- 6.2.12.8.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds, return the selector to Manual.
- 6.2.12.8.2 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.3 Sight through the SXT. Using the control stick align the SXT SLOS with optical Target No. 1 on the G&N Installation Fixture Model A23-097. Set the CONTROLLER SPEED switch to LO as the target is approached. When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.
- 6.2.12.8.4 Sight through the SXT. Using the control stick align the SXT SLOS with Optical Target No. 2 on A23-097. Set the CONTROLLER SPEED switch to LO as the target is approached.
- 6.2.12.8.5 When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.
- 6.2.12.8.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds set the switch to CMC.
- 6.2.12.8.7 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.8 Enter the value recorded from R1 in 6.2.12.8.3 into the K-Start. Press the enter pushbutton.
- 6.2.12.8.9 Enter the value recorded from R2 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.10 Sight through the SXT. The SLOS should be centered on Optical Target No. 1 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.3 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.11 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.12 Enter the value recorded from R1 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.

- 6.2.12.8.13 Enter the value recorded from R2 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.14 Sight through the SXT. The SLOS should be centered on Optical Target No. 2 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.5 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.15 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MANUAL.
- 6.2.12.8.16 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start 3 times. Press the ENTER pushbutton after each entry.
- 6.2.13 Optics Slew Rate Test
- NOTE: Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.13.1 Set/verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CB 1530) is +28.0±3.0 VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT. Set TRACKER switch to OFF.
- 6.2.13.2 Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.
- a. VERB 41 NOUN 20, ENTER
  - b. +00000, ENTER
  - c. +00000, ENTER
  - d. +00000, ENTER
- 6.2.13.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the positions indicated.
- a. TELESCOPE TRUNNION to SLAVE to SXT
  - b. CONTROLLER COUPLING to DIRECT
  - c. CONTROLLER SPEED to HI
- 6.2.13.4 Monitor MARK Command by entering VERB 06 NOUN 56 into K-148. Press the ENTER pushbutton.



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**6.2.13.5** Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. -Wait 15 seconds. Set the OPTICS MODE switch on the G&N Indicator Panel to MAN.

**a. SXT TRUNNION TACH O/P (CG 3150 LINK 2) shall be 3.3±1.3 VRMS**  
**b. SCT TRUNNION TACH O/P (CG 3170 LINK 2) shall be -0.85±0.35 VRMS**  
**NOTE: Read and understand step 6.2.13.6 before proceeding. Do not hold Control Stick at upper limit more than 10 seconds, or exceed a trunnion angle of 85 degrees, Control Stick at upper limit more than 10 seconds, or exceed a**

a. R2 = ±XX.XXX (Trunnion LOS angle in deg)  
b. R3 = +XXX.XX (Time in seconds)

**6.2.13.7**      **Perform the following calculations:**

a. Difference between R2 displays = \_\_\_\_\_ (Δ trunnion angle)  
 b. Difference between R3 displays = \_\_\_\_\_ (Δ time)  
 c.  $\frac{\Delta \text{trunnion angle}}{\Delta \text{time}} = \text{---} \text{ deg/sec}$

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# SHAFT SLEW RATE - HI SPEED

6.2.13.8 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the EXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion Aligned to EXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

6.2.13.8.1 During the Shaft Slew Rate Test - HI Speed, monitor and verify the following signals on the CRT.

- a. EXT SHAFT TACH O/P (CG 3140 Link 2) shall be  $3.5 \pm 1.3$  VRMS
  - b. SCT SHAFT TACH O/P (CG 3160 Link 2) shall be  $-3.5 \pm 1.3$  VRMS
- NOTE: Read and understand step 6.2.13.9 before proceeding. Do not hold Control Stick at right limit for more than 10 seconds, or exceed a shaft angle of 250 degrees.

6.2.13.9 While slewing the optics, record the EXT SHAFT SERVO error (CG 3117): it shall be between -0.25 and -2.0 VRMS.

6.2.13.9 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R1 = +XXX.XX (shaft angles in deg)
- b. R3 = +XXX.XX (time in seconds)

After the display has changed, again record the values of R1 and R3.

6.2.13.10 Perform the following calculations:

- a. Difference between R1 displays = \_\_\_\_ . \_\_\_\_ ( $\Delta$  shaft angle)
- b. Difference between R3 displays = \_\_\_\_ . \_\_\_\_ ( $\Delta$  time)
- c.  $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{____ . ____ deg/sec}$

The Shaft Slew Rate shall be  $19.5 \pm 3.9$  deg/sec.

# TRUNNION SLEW RATE - MED SPEED

- 6.2.13.11 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to MED. Monitor MARK command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.12 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

- 6.2.13.12 Record the SXT TRUN MTR control winding (CG 3155) and SXT TRUN TACH (CG 3150) signals on the CRT while slewing the optics. CG 3155 shall be  $\pm 0.25$  to  $\pm 0.00$  VRMS, and CG 3150 shall be  $\pm 0.33 \pm 0.13$  VRMS. Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R2 =  $\pm XX.XXX$  (trunnion LOS angle in deg)
- b. R3 =  $\pm XXX.XX$  (time in seconds)

After the display has changed, again record the values of R2 and R3.

- 6.2.13.13 Perform the following calculations:

- a. Difference between R2 displays =  $\text{---} \cdot \text{---} \text{---}$  ( $\Delta$  trunnion angle)
- b. Difference between R3 displays =  $\text{---} \cdot \text{---} \text{---}$  ( $\Delta$  time)
- c.  $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}} = \text{---} \cdot \text{---} \text{---} \text{ deg/sec}$

The Trunnion Slew Rate shall be  $1.0 \pm 0.2 \text{ deg/sec}$ .

# SHAFT SLEW RATE - MED SPEED

- 6.2.13.14 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS Mode switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.15 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.15  
6.2.13.15

Record the EXT SHAFT MTR control winding (CG 3146), EXT SHAFT TACH (CG 3147) and EXT SHAFT TACH (CG 3148) signals on the CRT while slewing the optics. CG 3146 shall be  $\pm 0.50$  to  $\pm 4.00$  VRMS, and CG 3147 shall be  $0.33 \pm 0.15$  VRMS. Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 6 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R1 =  $\pm XXX.XX$  (shaft angle in deg)
- b. R3 =  $\pm XXX.XX$  (time in seconds)

After display has changed, again record the values of R1 and R3.

6.2.13.16

Perform the following calculations:

- a. Difference between R1 displays =  $\text{---}^\circ \text{---}$  ( $\Delta$  shaft angle)
- b. Difference between R3 displays =  $\text{---}^\circ \text{---}$  ( $\Delta$  time)
- c.  $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \text{---}^\circ \text{---} \text{ deg/sec}$

The Shaft Slew Rate shall be  $2.0 \pm 0.4 \text{ deg/sec}$ .

#### TRUNNION SLEW RATE - LO SPEED

6.2.13.17

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the EXT Trunnion to within  $\pm 6$  degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to EXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the Controller SPEED switch to LO. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

6.2.13.17.1

During the Trunnion Slew Rate Test-Lo Speed, monitor and verify the following signal on the CRT.

- a. TRUNNION CDU FINE ERROR (CG 3011 Link 2)  $\pm 0.07$  VRMS MAX

NOTE: Read and understand 6.2.13.18 before proceeding. Do not hold control stick at upper limit for more than 30 seconds.

6.2.13.18

Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 6 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R2 =  $\pm XX.XXX$  (trunnion LOS angle in deg)
- b. R3 =  $\pm XXX.XX$  (time in seconds)

After the display has changed, again record the values of R2 and R3.

- 6.2.13.19**      **Perform the following calculations:**
- Difference between R2 displays = XX.XXX (Δ trunnion angle)
  - Difference between R3 displays = XXX.XX (Δ time)
  - $\frac{\Delta \text{trunnion angle}}{\Delta \text{time}} = \text{---} \text{ deg/sec}$

**The Trunnion Slew Rate shall be  $0.10 \pm 0.02$  deg/sec**

### SHAFT SLEW RATE - LO SPEED

- 6.2.13.30**      Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Monitor MARK Command by entering Verb 06 NOUN 56 in K-148. Press the ENTER pushbutton.

- 6.2.13.20.1** During the Shaft Slew Rate Test - Lo Speed, monitor and verify the following signal on the CRT.

- a. SHAFT CDU FINE ERROR (CG 3021 Line 2)  $\pm .07$  VRMS MAX

**NOTE: Read and understand 6.2.13.21 before proceeding. Do not hold control stick at right limit for more than 20 seconds.**

- 6.2.13.21** Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:
- a. R1 = +XXX.XX (shaft angles in deg)  
b. R3 = +XXX.XX (time in seconds)

**After the display has changed, again record the values of R1 and R3.**

- 6.2.13.22**      **Perform the following calculations:**
- Difference between R1 displays = \_\_\_\_ · \_\_\_\_ (Δ shaft angle)
  - Difference between R3 displays = \_\_\_\_ · \_\_\_\_ (Δ time)
  - $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \_ \cdot \_ \text{ deg/sec}$

**The Shaft Slew Rate shall be  $0.20 \pm 0.04$  deg/sec**

# OPTICS HAND CONTROLLER DRIFT RATE CHECK-LO SPEED

6.2.13.23 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

6.2.13.24 Press the MARK pushbutton and record the display in R1, R2, and R3. Approximately 60 seconds after the first MARK, again press the first MARK pushbutton and record the new data displayed in R1, R2 and R3. The data displayed is in the following form:

- a. R1 = ±XXX.XX (shaft angle in deg)
- b. R2 = ±XX.XXX (trunnion LOS angle in deg)
- c. R3 = +XXX.XX (time in seconds)

6.2.13.25 Perform the following calculations:

- a. Difference between R1 displays = \_\_\_\_\_ (Δ shaft angle)
- b. Difference between R2 displays = \_\_\_\_\_ (Δ trunnion angle)
- c. Difference between R3 displays = \_\_\_\_\_ (Δ time)
- d.  $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{_____ deg/sec (Shaft Drift Rate)}$

Shall be less than 0.0333 deg/sec.

- e.  $\frac{\Delta \text{trunnion angle}}{\Delta \text{time}} = \text{_____ deg/sec (Trunnion Drift Rate)}$

Shall be less than 0.0167 deg/sec.

6.2.13.26 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

Addition 14. Replace Paragraph 6.2.17.5 and 6.2.17.20 with the following:

6.2.17.5 On the G&N Indicator Control Panel, set the following switches to the position indicated.

- a. TELESCOPE TRUNNION to SLAVE to SXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to LO
- d. OPTICS MODE to MAN

6.2.17.20 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within  $\pm 8$  degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN. Enter VERB 33, ENTER into the DSKY.

Addition 15. Replace Paragraphs 6.2.18.10.1, 6.2.18.10.2, 6.2.18.19, 6.2.18.20, and 6.2.18.22 with the following:

6.2.18.10.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within  $\pm 8$  degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Between 235 minutes and 240 minutes from  $T_0$  set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.

6.2.18.10.2 Enter the following into the DSKY:

- a. VERB 21 NOUN 03 ENTER
- b. 02663 ENTER
- c. +XXX.XX&000.01 ENTER (Target No. 1 As)
- d. Press ENTER pushbutton
- e. 02664 ENTER
- f. +XXX.XX&000.01 ENTER (Target No. 2 As)
- g. Press ENTER pushbutton
- h. 02665 ENTER
- i. +00.000 ENTER (Target No. 1 EL)
- j. Press ENTER pushbutton
- k. 02666 ENTER
- l. +00.000 ENTER (Target No. 2 EL)

On the G&N Indicator Control Panel, set the OPTICS MODE switch to MAN and the CONTROLLER SPEED switch to HI. Drive the St. LOS to the approximate position of Target No. 1. Set the CONTROLLER SPEED switch to LO.

NOTE: Read the following 10 steps before proceeding. These are time critical steps and must be performed as rapidly as possible.

6.2.18.19 Set the CONTROLLER SPEED switch to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target 2.

6.2.18.20 Set the CONTROLLER SPEED switch to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 2 and press the MARK pushbutton. If satisfied that the MARK was good, press the ENTER pushbutton. If not satisfied, press the MARK REJECT pushbutton and repeat this step.

- 6.2.18.22** Enter VERB 34 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT and DSKY's indicate 02. Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +8 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the G&N Indicator Control Panel to Zero.
- Addition 16.** Replace Paragraph 6.2.20.3.2, 6.2.20.3.22, and 6.2.20.3.29 with the following:
- 6.2.20.3.2** Set the OPTICS MODE selector on the Indicator Control Panel to MAN.
- 6.2.20.3.22** Set the OPTICS CONTROLLER SPEED switch on the Indicator Control Panel to HI.
- 6.2.20.3.29** Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +8 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the Indicator Control Panel to ZERO for 30 seconds, then return to MAN.



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## ADDENDUM II

**SCOPE:** The following changes are required to make ND1002325 applicable as G&N System technical support documentation for systems containing SUNDIAL C test ropes. Refer to Drawing 2014999 to define further which test ropes and jumper modules shall be installed.

**Change 1:** Paragraphs 6.2.9.1.4, 6.2.9.2a, 6.2.9.3a, 6.2.9.5a, 6.2.9.6a, 6.2.9.7a, 6.2.9.8, 6.2.9.10a, 6.2.9.11a, 6.2.9.13a, 6.2.9.15a, 6.2.9.16a, 6.2.9.23. In each of these paragraphs change "VERB 06 NOUN XX flashing" to "VERB 33 NOUN XX flashing."

**Change 2:** Paragraphs 6.2.20.2.2a, 6.2.20.2.4a, 6.2.20.2.7a, 6.2.20.2.10a, 6.2.20.2.13a, 6.2.20.2.16a, 6.2.20.2.19a, 6.2.20.2.22a, 6.2.20.2.25a, 6.2.20.2.28a, 6.2.20.2.31a, 6.2.20.2.34a, 6.2.20.2.37a, 6.2.20.2.8a, 6.2.20.3.11a, 6.2.20.3.14a, 6.2.20.3.17a, 6.2.20.3.20a, 6.2.20.3.24a, 6.2.20.3.27a, 6.2.20.3.31a, 6.2.20.3.34a, 6.2.20.3.37a, 6.2.20.3.40a; in each of these steps, change "V06" to "V33".

**Change 3:** Paragraph 6.2.16.7.19 Change FROM: On K-148 enter the following sequence:

|         |         |      |
|---------|---------|------|
| VERB 21 | NOUN 01 | ENTR |
| 00407   |         | ENTR |
| 77757   |         | ENTR |
| VERB 21 | NOUN 01 | ENTR |
| 00411   |         | ENTR |
| 00020   |         | ENTR |
| VERB 33 |         | ENTR |

Change TO: On K-148 enter the following sequence:

|         |         |      |
|---------|---------|------|
| VERB 21 | NOUN 01 | ENTR |
| 02502   |         | ENTR |
| 77757   |         | ENTR |
| VERB 21 | NOUN 01 | ENTR |
| 02504   |         | ENTR |
| 00020   |         | ENTR |
| VERB 33 |         | ENTR |

**Change 4:** Paragraph 6.2.16.7.33 Change FROM: On K-148 enter the following sequence:

|         |         |      |
|---------|---------|------|
| VERB 21 | NOUN 01 | ENTR |
| 00405   |         | ENTR |
| 00020   |         | ENTR |
| VERB 21 | NOUN 01 | ENTR |
| 00407   |         | ENTR |
| 77757   |         | ENTR |
| VERB 33 |         | ENTR |

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### ADDENDUM II

Change 4  
(Continued)

Change TO: On K-148 enter the following sequence:

|         |         |      |
|---------|---------|------|
| VERB 21 | NOUN 01 | ENTR |
| 02500   |         | ENTR |
| 00020   |         | ENTR |
| VERB 21 | NOUN 01 | ENTR |
| 02502   |         | ENTR |
| 77757   |         | ENTR |
| VERB 33 |         | ENTR |

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### ADDENDUM III

**SCOPE.** The following changes are required to make ND1002325 applicable on G&N System technical support documentation for CSM 2TV-1.

**Change:1:** Make the changes as specified in Additions 11 through 20 of Addendum I.  
Delete the following paragraphs from Addition 17: 6.2.13.5.1, 6.2.13.8.1,  
6.2.13.17.1, 6.2.13.20.1.

APOLLO G&N Specification  
 ND1002325 REV S  
 Original Issue Date:  
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 Class A Release

POST INSTALLATION CHECKOUT PROCESS  
 SPECIFICATION FOR THE APOLLO GUIDANCE  
 AND NAVIGATION SYSTEM - BLOCK II

Record of Revisions

| Date     | Revision Letter | TDRR No. | Pages Revised                                                                                                                 | Approvals |      |
|----------|-----------------|----------|-------------------------------------------------------------------------------------------------------------------------------|-----------|------|
|          |                 |          |                                                                                                                               | AC        | NASA |
| 8/21/68  | M               | 36708    | 8-13, 33-36, 45, 66, 67, 71, 72, 81, 103-162. Was 162 pages, now 163 pages. Specification now comprises a total of 165 pages. | SB        | WLS  |
| 9/5/68   | N               | 36791    | 8                                                                                                                             | EA        | WLS  |
| 9/27/68  | P               | 36871    | 66, 67, 68                                                                                                                    | EA        | WLS  |
| 10/24/68 | R               | 36954    | 58, 112, 113, 115, 116, 117 through 167. Was 163 pages; now 167 pages.                                                        | EA        | WLS  |
| 12/16/68 | S               | 37123    | 11, 13, 29, 35, 43, 44, 81, 85, 72, 111 and 126                                                                               | EA        | WLS  |

This specification consists of pages 1 to 167 including Appendix I, pages 142-143, Addendum I, pages 144-164 Addendum II, pages 165-166 and Addendum III, page 167.

|           |                                          |        |              |              |
|-----------|------------------------------------------|--------|--------------|--------------|
| APPROVALS | Not required per CCA-497-0274<br>NASA/MS | MIT/IL | R. D. Petryk | D. A. Ziemer |
|           |                                          |        | AC           |              |

6.2.16.7.X where X is listed below

6.2.16.1  
THRU  
6.2.16.7.7

[illegible]

- ```

* Perform step and wait 20 sec. before proceeding.

A On K-148 enter the following
  W25      ENTER
  +00001   ENTER
  +00000   ENTER
  +0000X   ENTER Where X is the Test position number represented in DSKY Row 3 display.

B When W25 06 HOUR 06 flashes do not record test results.

```

TABLE 1 **RETEST SEQUENCE**

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6.2.2.3 CAUTION and STATUS Displays

6.2.2.3.1 Enter VERB 35, ENIR, into LEB CMC DSKY.

6.2.2.3.2 The following MDC and LEB CMC DSKY displays shall illuminate for approximately 5 seconds.

- a. UPLINK ACTY
 - b. NO ATT
 - c. STBY
 - d. KEY REL Flashing
 - e. TEMP
 - f. GIMBAL LOCK
 - g. PROG
 - h. RESTART
 - i. TRACKER
 - j. OPR ERROR Flashing
 - k. COMP ACTY (only momentarily ON)
 - l. VERB-NOUN Flashing
 - m. Plus 88888 in R1, R2, and R3
 - n. PGNS, CMC, and ISS caution lights. (CMC shall remain illuminated for 15.5 seconds.)
- After indications a through l go out +88888 shall remain in R1, R2, R3.

After indications a through l go out +88888 shall remain in R1, R2, R3.

6.2.2.8

TC Trap Test

6.2.2.8.1

Enter the following sequence into K-148:

- a. VERB 21 NOUN 01 ENTR
- b. 01470 ENTR
- c. 31474 ENTR
- d. NOUN 15 ENTR
- e. 54067 ENTR ENTR
- f. 31475 ENTR ENTR
- g. 54001 ENTR ENTR
- h. 14613 ENTR ENTR
- i. 00067 ENTR
- j. VERB 25 NOUN 26 ENTR
- k. 35000 ENTR
- l. 01470 ENTR
- m. 00003 ENTR
- n. VERB 30 ENTR

The RESTART and PROG lamps on the MDC and LEB DSKY's shall illuminate.
The PGNS caution lamps on the MDC and LEB annunciator panels shall illuminate.

6.2.2.8.2

Press the ERROR RESET pushbutton on the K-148. All alarms shall clear.

6.2.2.8.3

Enter VERB 36 ENTR into K-148.

6.2.2.8.4

Enter the following sequence into K-148:

- a. VERB 21 NOUN 01 ENTR
- b. 01470 ENTR
- c. 30067 ENTR
- d. NOUN 15 ENTR
- e. 31474 ENTR ENTR
- f. 22000 ENTR ENTR
- g. 22005 ENTR ENTR
- h. 01470 ENTR
- i. VERB 25 NOUN 26 ENTR
- j. 36000 ENTR
- k. 01470 ENTR
- l. 00003 ENTR
- m. VERB 30 ENTR

The RESTART and PROG lamps on the MDC and LEB DSKY's shall illuminate.
The PGNS caution lamps on the MDC and LEB annunciator panels shall illuminate.

6.2.2.8.5

Press the ERROR RESET pushbutton on the K-148. All alarms shall clear.

6.2.2.8.6

Enter VERB 36 into K-148. Press ENTR pushbutton.

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6.2.3.2 Optics Power On

6.2.3.2.1 Optics power shall be applied by actuating the G&N OPTICS MN A and OPTICS MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in), and placing G/N Power - OPTICS switch on the LEB Lighting Control Panel to ON.

6.2.3.2.2 OPTICS +28 VDC discrete shall be issued (CG 1533). Verify by observing that the OPTICS lamp on Event Module is illuminated. Verify that the +28 VDC OPTX OPERATE BUS (CG 1530) is +28.8±3 VDC. Record the indication on the CRT.

6.2.3.2.3 Verify the following secondary power supply voltages on the CRT are not flashing:

CG 1211 OPTX 28V 800 CPS 1 pct 0 ph
CG 1212 OPTX 800 CPS 5 pct-90 ph

6.2.3.3 IMU Cage Test

6.2.3.3.1 Enter the following into the DSKY:

- a. VERB 40 NOUN 20, ENTER (wait 3 seconds)
- b. VERB 41 NOUN 20, ENTER
- c. +00200, ENTER
- d. +00200, ENTER
- e. +00200, ENTER

Observe that the NO ATT lamps on the DSKY's light and that CDUX, CDUY, CDUZ on the CRT indicate approximately +00200.

6.2.3.3.2 Set up the Analog Recorder to monitor the following signals:

- a. IG 1X Resolver Output Sine (CG 2112)
- b. MG 1X Resolver Output Sine (CG 2142)
- c. OG 1X Resolver Output Sine (CG 2172)

Start the Analog Recorders.

6.2.3.3.3 On MDC panel 1, press and hold the IMU CAGE switch in the CAGE position. On the CRT, verify that the 1X Sine signals (CG 2112, CG 2142, CG 2172) null out at 0.5V rms or less.

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- 6.2.3.3.4 Release the IMU CAGE switch. Disregard any momentary transients on the LX Resolver Sine signals when the switch is released. Sustained oscillations shall be cause for immediate removal of IMU OPERATE power.
- 6.2.3.3.4.1 Enter the following on the DSKY:
G/VERB 36 - ENTER CDUX, CDUY and CDUZ are all between +00150
- 6.2.3.3.5 On the CRT verify that CDUX, CDUY and CDUZ are all between +35850 and +00150.
- 6.2.3.3.6 Stop the Analog Recorders.
- 6.2.4 G&N System Power Supplies Test
- 6.2.4.1 Proceed with this test if 6.2.3, Operate Power On Test, has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding with this test. Insure that the IMU Operate Power has been on for at least 15 minutes before proceeding with this test.
- 6.2.4.2 Enter the following sequence into the K-Start. Verb 41 NOUN 20, ENTER; +00000 ENTER; +00000 ENTER, +00000 ENTER.
- 6.2.4.3 Set/Verify the following circuit breakers and switches on the Right Hand Circuit Breaker Panel and LEB.
- COMPUTER MN A to ON (pushed in) and COMPUTER MN B to OFF (pulled out).
 - G/N - POWER to AC1.
 - IMU HTR MNA to ON (pushed in) and IMU HTR MNB to OFF (pulled out).
 - IMU MNA to ON (pushed in) and IMU MN B to OFF (pulled out).
 - G/N POWER - IMU to IMU
 - OPTICS MNA to ON (pushed in) and OPTICS MN B to OFF (pulled out).
 - G/N POWER - OPTICS to OPTICS
- 6.2.4.4 Record the voltage indicated on the CRT for the following signals:
- The +28 VDC IMU OPERATE (Buss No. 1) output voltage shall be +28.8±3 VDC (CG 1500).
 - The +28 VDC IMU STANDBY (Buss No. 2) output voltage shall be +28.8±3 VDC (CG 1510).
 - The +28 VDC CMC OPERATE (Buss No. 3) output voltage shall be +28.8±3 VDC (CG 1520).
 - The +28 VDC OPTX OPERATE (Buss No. 4) output voltage shall be +28.8±3 VDC (CG 1530).
 - The CG 2221, IGA CDU Coarse Error measurement shall be 0.0±0.68 VRMS
 - The CG 2251 MGA CDU Coarse Error measurement shall be 0.0±0.68 VRMS
 - The CG 2281 OGA CDU Coarse Error measurement shall be 0.0±0.68 VRMS.

6.2.5.2.8.4

Enter the following in K-148 to turn on the Computer Activity Light.

- a. VERB 34 ENTR
- b. VERB 21 NOUN 27 ENTR
- c. 00000 ENTR
- d. VERB 25 NOUN 01 ENTR
- e. 03770 ENTR SET LOC
- f. 10067 ENTR CCS NEW JOB
- g. 04317 ENTR TC CHANG1
- h. 01770 ENTR TC ACTLITON
- i. VERB 25 NOUN 26 ENTR CALL PRIO/DELAY
- j. 01000 ENTR 01 PRIORITY
- k. 01770 ENTR RELATIVE E-MEM
- m. 00007 ENTR BANKADD
- n. VERB 30 ENTR REQ EXEC

NOTE: If a VERB 36 is performed after the above information has been entered repeat lines 6.2.5.2.8.4.1 through 6.2.5.2.8.4.n. An exception is the VERB 36 performed when entering Voltage Margin Test (6.2.19). After completing Voltage Margin Test, repeat lines 6.2.5.2.8.4.1 through 6.2.5.2.8.4.n.

NOTE: Allow 2 hours to elapse before proceeding to 6.2.5.2.9 with the following exceptions:

- a. If the G&N System has been in the power off state for less than 5 days with the gimbals in the following positions,

X = 000.00±005.00 deg
Y = 000.00±005.00 deg
Z = 090.00±005.00 deg

or has been in the power off state for less than 12 days with the gimbals in the following positions.

X = 000.00±001.00 deg
Y = 000.00±001.00 deg
Z = 090.00±001.00 deg

and the system has not been moved, allow 15 minutes to elapse before proceeding.

- b. If the G&N System has been turned off with the gimbals in the unparked position for less than 2 hours allow a warmup time equal to the time off but not less than 15 minutes to elapse before proceeding.

CAUTION: If the requirements of 6.2.5.2.10 are not met, remove IMU Operate Power immediately by setting the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

6.2.5.2.9

After the required warmup time has elapsed set the G&N IMU MN A and MN B circuit breaker on the Right Hand circuit breaker panel to ON (breaker pushed in) and the G/N POWER-IMU switch on the LEB Lighting Control Panel to the ON position (toggle-up).

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X_1 = data point just obtained
 X_{1-1} = last historical data point
 X_{1-2} = second last historical data point
 X_{1-3} = third last historical data point

NOTE: D_1 calculations begin with the first data point after ISS Pre-Vib; D_2 calculations begin with the second data point after ISS Pre-Vib; D_3 calculations begin with the third data point after Pre-Vib.

TABLE D

PARAMETER	UNITS	D_1	MAX	D_2	MAX	D_3	MAX
NBDX	meru		6.0		9.0		11.0
NBDY	meru		6.0		9.0		11.0
NBDZ	meru		6.0		9.0		11.0
ADSRAX	meru/g		14.0		21.0		25.0
ADSRAY	meru/g		14.0		21.0		25.0
ADSRZ	meru/g		14.0		21.0		25.0
ADIAx	meru/g		17.0		33.0		40.0
ADIAy	meru/g		17.0		33.0		40.0
ADIAz	meru/g		17.0		33.0		40.0
X PIPA S. F. Error	PPM		400		500		600
Y PIPA S. F. Error	PPM		400		500		600
Z PIPA S. F. Error	PPM		400		500		600
X PIPA Bias	cm/sec ²		0.50		0.70		0.90
Y PIPA Bias	cm/sec ²		0.50		0.70		0.90
Z PIPA Bias	cm/sec ²		0.50		0.70		0.90

6.2.16.10.9 Failure to meet the above criteria shall result in retest according to paragraph 5.4.2.

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6.2.18.25 Data Sheet

TIME	CDUX	CDUY	CDUZ
To			
To +15			
To +30			
To +45			
To +60			
To +75			
To +90			
To +105			
To +120			
To +125			
To +130			
To +135			
To +140			
To +145			
To +150			
To +155			
To +160			
To +165			
To +170			
To +175			
To +180			

- NOTES: 1. Record CDU angles at times indicated. (T_0 is the time at the start of test - Prog 02)
2. CDU zero data ($T_0 + 10$ minutes) is baseline.

Tolerance: CDU angles ± 0.001 degrees from 0 hr baseline for CDUX, ± 0.001 degrees from 0 hr baseline for CDUY & CDUZ for the 120 minutes to 180 minutes recording only.

Line	Step	Parameter	Recorded Value
1	6.2.18.21	X Gyro Elevation Error	$\pm R1$ degrees
2		Y Gyro Elevation Error	$\pm R2$ degrees
3		Z Gyro Azimuth Error	$\pm R3$ degrees

6.2.18.26 Calculation Sheet

6.2.18.26.1 Record the most recent values of the following coefficients from 6.2.16, IMU Performance Test.

- a. NBDX = () _____
- b. NBDY = () _____
- c. NBDZ = () _____
- d. ADIAZ = () _____
- e. ADSRAY = () _____

APOLLO G&N Specification
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POST INSTALLATION CHECKOUT PROCESS
 SPECIFICATION FOR THE APOLLO GUIDANCE
 AND NAVIGATION SYSTEM - BLOCK II

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
8/21/68	M	36708	8-13, 33, 36, 45, 66, 67, 71, 72, 81, 103-162. Was 162 pages, now 163 pages. Specification now comprises a total of 165 pages.	SB	WLS
9/5/68	N	36791	8	EA	WLS
9/27/68	P	36871	66, 67, 68	EA	WLS
10/24/68	R	36954	58, 112, 113, 115, 116, 117 through 167. Was 163 pages; now 167 pages.	EA	WLS
12/16/68	S	37123	11, 13, 29, 35, 43, 44, 61, 65, 70, 111 and 126	EA	WLS
3/7/69	T	37392	34, 35, 40, 43, 45-49, 64, 73-75, 127, 129	EA, 1. pages	RJJ

This specification consists of pages 1 to 167 including Appendix I, pages 142-143, Addendum I, pages 144-164 Addendum II, pages 165-166 and Addendum III, page 167.

APPROVALS	Not required per CCA-497-0874 NASA/MSC	MIT/IL	R.D. Petryk	D.A. Ziemer
			AC	

6.2.2.7 Rupt Lock Test

6.2.2.7.1 Enter the following sequence into the K-START:

- a. VERB 25 NOUN 01 ENTR
- b. 01600 ENTR
- c. 00004 ENTR
- d. 30067 ENTR
- e. 01600 ENTR
- f. VERB 25 NOUN 26 ENTR
- g. 00001 ENTR
- h. 01600 ENTR
- i. 00003 ENTR
- j. VERB 31 ENTR

The RESTART lamps on the MDC and LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC and LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and Row 1 shall indicate 00000.

6.2.2.7.2 Press the ERROR RESET pushbutton on the K-START. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.7.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

6.2.2.7.4 Enter the following sequence into the K-START:

- a. VERB 21 NOUN 26 ENTR
- b. 04000 ENTR
- c. VERB 30 ENTR

The RESTART lamps on the MDC and LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC and LEB annunciator panels shall illuminate. VERB 05 NOUN 31 shall be displayed on the MDC and LEB DSKY's and Row 1 shall indicate 00000.

6.2.2.7.5 Press the Error Reset pushbutton on the K-START. The RESTART and PGNS caution lamps shall extinguish.

6.2.2.7.6 Enter VERB 36 into the K-START. Press the ENTER pushbutton.

6.2.2.8 TC Trap Test

6.2.2.8.1 Enter the following sequence into K-148:

- a. VERB 21 NOUN 01 ENTR
- b. 01470 ENTR
- c. 31474 ENTR
- d. NOUN 15 ENTR
- e. 54067 ENTR ENTR
- f. 31475 ENTR ENTR
- g. 54001 ENTR ENTR
- h. 14613 ENTR ENTR
- i. 00067 ENTR
- j. VERB 25 NOUN 26 ENTR
- k. 35000 ENTR
- l. 01470 ENTR
- m. 00003 ENTR
- n. VERB 30 ENTR

The RESTART lamps on the MDC and LEB DSKY's shall illuminate.
The PGNS caution lamps on the MDC and LEB annunciator panels shall illuminate.

6.2.2.8.2 Press the ERROR RESET pushbutton on the K-148. All alarms shall clear.

6.2.2.8.3 Enter VERB 36 ENTR into K-148.

6.2.2.8.4 Enter the following sequence into K-148:

- a. VERB 21 NOUN 01 ENTR
- b. 01470 ENTR
- c. 30067 ENTR
- d. NOUN 15 ENTR
- e. 31474 ENTR ENTR
- f. 22000 ENTR ENTR
- g. 22005 ENTR ENTR
- h. 01470 ENTR
- i. VERB 25 NOUN 26 ENTR
- j. 36000 ENTR
- k. 01470 ENTR
- l. 00003 ENTR
- m. VERB 30 ENTR

The RESTART lamps on the MDC and LEB DSKY's shall illuminate.
The PGNS caution lamps on the MDC and LEB annunciator panels shall illuminate.

6.2.2.8.5 Press the ERROR RESET pushbutton on the K-148. All alarms shall clear.

6.2.2.8.6 Enter VERB 36 into K-148. Press ENTR pushbutton.

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6.2.3 Operate Power On Test

6.2.3.1 IMU Operate Power ON

CAUTION: The sequences specified in this test must be adhered to. Deviations may necessitate recalibration of the inertial components.

NOTE: Disregard the GIMBAL LOCK indicator until the completion of step 6.2.3.1.6.

6.2.3.1.1 The following Command Module switches and circuit breakers shall be in the following state:

Right Hand Circuit Breaker Panel

- a. GUIDANCE/NAVIGATION COMPUTER MN A and MN B breakers on (Pushed in)
- b. GUIDANCE/NAVIGATION IMU HTR MN A and MN B breakers on (pushed in)
- c. GUIDANCE/NAVIGATION IMU MN A and MN B breakers off (pulled out)
- d. GUIDANCE/NAVIGATION OPTICS MN A and MN B breakers off (pulled out)

LEB Lighting Control Panel

- e. G/N Power - IMU set to OFF
- f. G/N Power - Optics set to OFF

6.2.3.1.2 Switches and selectors on the G&N Indicator Control Panel shall be set as follows:

- a. OPTICS ZERO to OFF
- b. OPTICS MODE TO MAN
- c. OPTICS COUPLING TO DIRECT
- d. OPTICS SPEED to MED
- e. OPTICS TEL TRUN to SLAVE to SXT
- f. RETICLE BRIGHTNESS to minimum brightness position.

6.2.3.1.3 Adjust the Command Module MDC and LEB Lighting Controls to minimum intensity for proper readout of G&N displays.

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6.2.3.2 Optics Power On

6.2.3.2.1 Optics power shall be applied by actuating the G&N OPTICS MN A and OPTICS MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in), and placing G/N Power - OPTICS switch on the LEB Lighting Control Panel to ON.

6.2.3.2.2 OPTICS +28 VDC discrete shall be issued (CG 1533). Verify by observing that the OPTICS lamp on Event Module is illuminated. Verify that the +28 VDC OPTX OPERATE BUS (CG 1530) is +28.8±3 VDC. Record the indication on the CRT.

6.2.3.2.3 Verify the following secondary power supply voltages on the CRT are not flashing:

CG 1211 OPTX 28V 800 CPS 1 pct 0 ph

CG 1212 OPTX 800 CPS 5 pct-90 ph

6.1.3.2.4 Drive Optics Trunnion to less than 5 degrees, set OPTICS ZERO switch to ZERO.

6.2.3.3 IMU Cage Test

6.2.3.3.1 Enter the following into the DSKY:

a. VERB 40 NOUN 20, ENTER (wait 3 seconds)

b. VERB 41 NOUN 20, ENTER

c. +00200, ENTER

d. +00200, ENTER

e. +00200, ENTER

Observe that the NO ATT lamps on the DSKY's light and that CDUX, CDUY, CDUZ on the CRT indicate approximately +00200.

6.2.3.3.2 Set up the Analog Recorder to monitor the following signals:

a. IG 1X Resolver Output Sine (CG 2112)

b. MG 1X Resolver Output Sine (CG 2142)

c. OG 1X Resolver Output Sine (CG 2172)

Start the Analog Recorders.

6.2.3.3.3 On MDC panel 1, press and hold the IMU CAGE switch in the CAGE position. On the CRT, verify that the 1X Sine signals (CG 2112, CG 2142, CG 2142, and CG 2172) null out at 0.5V rms or less.

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- 6.2.4.9 Set/Verify the following circuit breakers and switches on the Right Hand Circuit Breaker Panel and LEB:
- a. G/N POWER-OPTICS to OFF
 - b. OPTICS MN B to ON (pushed in) and OPTICS MN A to OFF (pulled out).
 - c. G/N POWER - IMU to OFF
 - d. IMU MN B to ON (pushed in) and IMU MN A to OFF (pulled out).
 - e. IMU HTR MNA to OFF (pulled out)
 - f. G/N - POWER to OFF
 - g. COMPUTER MN B to ON (pushed in) and COMPUTER MN A to OFF (pulled out).
 - h. On GNIC panel, set OPTICS ZERO to OFF.
- 6.2.4.10 Verify that the +28 VDC CMC OPERATE output voltage is +28.8±3 VDC (CG 1520).
- 6.2.4.11 Set the G/N - POWER switch on the LEB to AC2. Set the IMU HTR MN B to ON (pushed in). Verify that the +28 VDC IMU STANDBY output voltage is +28.8±3 VDC (CG 1500).
- 6.2.4.12 Wait until 15 minutes have elapsed since setting G/N POWER - IMU to OFF in 6.2.4.9.c then set the G/N POWER - IMU to IMU. Verify that the +28 VDC IMU OPERATE output Voltage is +28.8±3 VDC. (CG 1500).
- 6.2.4.13 Set the G/N POWER - OPTICS to OPTICS. Verify that the +28 VDC OPTX OPERATE output voltage is +28.8±3 VDC (CG 1530).
- 6.2.4.13.1 Drive optics in trunnion to less than 5 degrees. Set OPTICS ZERO to ZERO.
- 6.2.4.14 Repeat 6.2.4.5 through 6.2.4.8.
- 6.2.4.15 Set the following circuit breakers to the position indicated:
- a. Set the COMPUTER MN A to ON (pushed in).
 - b. Set the IMU HTR MNA to ON (pushed in).
 - c. Set the IMU MNA to ON (pushed in).
 - d. Set the OPTICS MN A to ON (pushed in).
- 6.2.4.16 Miscellaneous Checks - The following miscellaneous signals are required to supply data for system evaluation in the event of failure, or for trend analysis of system performance. Record the values displayed on the CRT for the following signals.
- a. CG 4300 CMC Temperature
 - b. CG 6020 PIPA Calibration Module Temperature
 - c. CG 6021 IMU 800 CPS 5% Temperature

- 6.2.5.1.6 Decrease the LIGHTS-NUMERICS controls on both the left hand circuit breaker panel and the LEB Lighting Control Panel to the minimum brightness - OFF position.
- 6.2.5.1.7 Set the PSAAM power switch on the PSAAM to OFF.
- 6.2.5.1.8 Set the IMU HTR MNA and MN B circuit breakers on the right hand circuit breaker panel to OFF (breakers pulled out).
- 6.2.5.1.9 Set the COMPUTER MN A and MN B circuit breakers on the right hand circuit breaker panel to OFF (breakers pulled out).
- 6.2.5.1.10 Set the G&N Power AC1-OFF-AC2 switch on the right hand circuit breaker panel to OFF and the G&N Power AC1 and AC2 circuit breakers to OFF (breakers pulled out).
- 6.2.5.1.11 Set the LTGNUMERIC/INTGL LEB and LTGNUMERIC/INTGL LMDC circuit breakers to OFF. Verify that the ICTC is supplying inertial components heater power to the G&N System. This will be indicated by the following on the PTC.
 - a. G&N ON (PTC inhibit) light not illuminated.
 - b. IMU Temp/heater current meter indicates IMU temperature of 130° ±5°F.
- 6.2.5.2 Turn ON Procedure
 - 6.2.5.2.1 Set or verify the following G&N Indicator Control Panel switches to the position indicated.
 - a. CONDITION LAMPS to ON
 - b. OPTICS ZERO to OFF
 - c. OPTICS MODE to MAN
 - d. OPTICS COUPLING to DIRECT
 - e. OPTICS SPEED to LO
 - f. OPTICS TEL TRUN to SLAVE to SXT
 - g. RETICLE BRIGHTNESS to minimum brightness setting.
 - Insure that interfacing system EPS and ECS are turned on and operating properly.
 - CAUTION: The remaining procedure must be followed in sequence specified. Failure to adhere to this sequence may require recalibration of the inertial components.
 - 6.2.5.2.2 Set the G&N Power AC1 and AC2 breakers on the right hand circuit breaker panel to ON (breakers pushed in). Set the G&N Power AC1-OFF-AC2 switch to AC1.

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6.2.5.3.5 Enter the following into K148:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

Observe the NO ATT lamp lights and the Inner, Outer, and Middle Gimbal angles are $0 \pm 1.5^\circ$ as indicated by the CDUX, CDUY, and CDUZ displays on the CRT.

6.2.5.3.6 Insure that the following switches are set to the positions indicated.

- a. OPTICS COUPLING to DIRECT
- b. OPTICS ZERO to OFF
- c. OPTICS MODE to MAN to SLAVE TO SXT
- d. OPTICS TEL TRUN to SLAVE to SXT
- e. OPTICS SPEED to LO to LO
- f. CONDITION LAMPS to ON
- g. UP TELEMETRY to ACCEPT

6.2.5.3.7 Deleted: ERROR RESET pushbutton. Enter the following into K148:

- a. VERB 57, ENTER
- b. 00015, ENTER

6.2.6 G&N Operational Test

6.2.6.1 Initial Conditions

Proceed with this test if the Operate Power On Test of 6.2.3 or the Turn on Procedure of 6.2.5 has been completed and system operation has not be interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding.

6.2.6.1.1 Enter the following into K-148:

- a. VERB 01 NOUN 10, ENTER
 - b. 00003, ENTER
- Record R1 = AAAAA and the time of day

6.2.6.1.2 Enter the following into K-148.

- a. VERB 21 NOUN 02, ENTER
 - b. 01300, ENTER
 - c. AAAAA, ENTER (from 6.2.6.1.1)
 - d. VERB 06 NOUN 02, ENTER
 - e. 01300, ENTER
- Record R1 = BBBB

6.2.6.1.3 Perform the following calculations:

- a. $\frac{R1 (BBBB) \times 5.12}{3600} = CC.C$ (hours in high order scaler Channel 03)

- 6.2.9.27.2.1 Perform the following on the DSKY.
VERB 21 NOUN 10 ENTR
00012 ENTR
00001 ENTR
Observe: Tracker fail and PGNS warning lamps on.
- 6.2.9.27.2.2 Perform the following on the DSKY.
VERB 21 NOUN 10 ENTR
00012 ENTR
00000 ENTR
Depress Error Reset and observe the Tracker fail and PGNS warning lamps off.
- 6.2.9.27.3 Using the Optics Hand Controller, drive the Optics Shaft until the shaft TPAC indicates 0.00 degree and drive the Optics Trunnion until the trunnion TPAC indicates 0.75 degree.
- 6.2.9.27.3.1 Perform the following on the DSKY.
VERB 21 NOUN 10 ENTR
00012 ENTR
00001 ENTR
Observe: Tracker fail and PGNS warning lamps on.
- 6.2.9.27.3.2 Perform the following on the DSKY.
VERB 21 NOUN 10 ENTR
00012 ENTR
00000 ENTR
Depress Error Reset.
- 6.2.9.27.4 Set the G/N Power-Optics switch on the LEB lighting control panel to OFF.
- 6.2.10 Zero Optics Test
NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 Turn On procedure before proceeding.
INITIALIZATION
- 6.2.10.1 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $+28.0 \pm 3.0$ VDC. Verify that the OPTIX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.
- 6.2.10.2 Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.
a. VERB 41 NOUN 20 ENTER
b. +00000, ENTER
c. +00000, ENTER
d. +00000, ENTER
- 6.2.10.3 Insure that the following switches on the G&N Indicator Control Panel are set as follows:
a. OPTICS TEL TRUN to SLAVE TO SXT
b. OPTICS COUPLING to DIRECT

6.2.10.3
(Cont)

- c. OPTICS SPEED to HI
- d. OPTICS MODE to MAN

OPTICS ZERO MODE TEST

6.2.10.4

Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K-148. Press the ENTER pushbutton.

6.2.10.5

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following on R1 and R2 of the DSKY.

- a. $R1 = +0.00^\circ +0.02^\circ, -0.03^\circ$ (Shaft Angle)
- b. $R2 = +0.000^\circ +0.006^\circ, -0.007^\circ$ (Trunnion Los Angle)

Record the TPAC indications. The Shaft Angle shall be 0.0 ± 0.11 degrees. The Trunnion Angle shall be 0.0 ± 0.22 degrees.

6.2.10.5.1

Enter the following:

VERB 01 NOUN 10, ENTER
00033, ENTER
Verify R1 = XXX6X

6.2.10.5.2

Return the OPTICS ZERO switch to OFF. Set the OPTICS MODE switch to CMC. Enter the following:

ENTER
00033, ENTER
Verify R1 = XXX5X

6.2.10.5.3

Set the OPTICS MODE switch to MAN. Press the KEY REL pushbutton on the DSKY.

OPTICS TIME TO ZERO TESTS

6.2.10.6

Deleted.

6.2.10.7

Deleted.

6.2.10.8

Deleted.

6.2.10.9

Deleted.

6.2.10.10

Deleted.

6.2.10.11

Deleted.

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6.2.18.26.2 Perform the following calculations. (Cos λ functions are provided in Table I.)

- a. $D_{(vert)} = NBDZ + ADIAZ$
 $D_{(vert)} = () \text{ meru}$
- b. $D_{(east)} = \sin(\text{Launch Az}) NBDX + \cos(\text{Launch Az}) NBDY + ADSRAY$
- c. $\phi_{(vert)} = \frac{D_{(vert)} \times \frac{12.8}{3600} + D_{(east)} \times \frac{206}{\cos \lambda}}{\cos \lambda}$
 $\phi_{(vert)} = () \text{ degrees}$

Table I

Location	Latitude λ	Cos λ
NAA	33.921	0.82985
MILA	28.516	0.87868
MSC	29.556	0.86993

6.2.18.26.3 Perform the following calculations using the recorded data from 6.2.18.25 and 6.2.18.26.2.

- a. Z Gyro azimuth error 3 hrs (corrected) = line 3 - $\phi_{(vert)}$
Z Gyro azimuth error 3 hrs (corrected) = _____ corrected
Z Gyro azimuth error (corrected) shall be 0.00 ± 0.573 degrees.
- b. X Gyro elevation error (3 hr) = line 1
X Gyro elevation error (3 hr) = _____ deg
X Gyro elevation error (comp) = X elevation error (R1) + (57.3 A_{BY}) / g
- c. Y Gyro elevation error (3 hr) = line 2
Y Gyro elevation error (3 hr) = _____ deg
Y Gyro elevation error (comp) = Y elevation error (R2) - (57.3 A_{BX}) / g

The X and Y compensated elevation errors shall be 0.00 ± 0.045 degree.

6.2.19 CMC Voltage Margin Test

6.2.19.1 Verify that the G&N IMU HTR MNA and MNB breakers are engaged, computer MNA and MNB breakers are engaged, IMU MNA and MNB breakers are not engaged, and the G&N Power-IMU switch on the LEB Lighting Control Panel is in the OFF position. On K-148, enter VERB 36 ENTR.

6.2.19.2 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to ON.

CAUTION: During the performance of this test the +4 VDC CMC Power Supply shall not be operated at less than +2.5 VDC or greater than 5.2 VDC (CG 1030). The +14 VDC CMC Power Supply shall not be operated at less than +8.5 VDC or greater than +17.0 VDC (CG 1020). Rotate the LEB LTS NUMERICS SEL to approximately center position. Decrease to absolute minimum

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- 6.2.19.11 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- ERROR RESET
 - VERB 21, NOUN 27, ENTER
 - 77777, ENTER
- 6.2.19.12 Units R-154, insert 0001. Verify and execute.
- 6.2.19.13 Insert in C-156 +108001244 and execute. Verify on CRT that GV0116 is between +9.8 and +11.8 vdc.
- 6.2.19.14 Units R-154, insert 0111. Verify and execute.
- 6.2.19.15 Observe CG 1020, +14 VDC Power Supply on CRT. Repeat 6.2.19.12 through 6.2.19.14 adjusting the C Start entry until CG 1020 is 16.4, +0.1, -0.0 vdc.
- 6.2.19.16 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- VERB 05, NOUN 31
 - R1 = 01102
- does not appear on DSKY.
- 6.2.19.16.1 Into R-154, insert 0111. Verify and execute.
- 6.2.19.17 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted. ~~Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148.~~
- 6.2.19.18 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- ERROR RESET
 - VERB 21, NOUN 27, ENTER
 - 77777, ENTER
- 6.2.19.19 Units R-154, insert 0001. Verify and execute.
- 6.2.19.20 Insert in C-156, +092001234 and execute. Verify on CRT that GV0106 is between +8.2 and +10.2 vdc.
- 6.2.19.21 Units R-154, insert 0111. Verify and execute.
- 6.2.19.22 Observe CG 1030, +4 VDC Power Supply on CRT. Repeat 6.2.19.19 through 6.2.19.21 adjusting the C Start entry until CG 1030 is 4.60, +0.08 -0.00 vdc.
- 6.2.19.23 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- VERB 05, NOUN 31
 - R1=01102
- does not appear on DSKY.
- 6.2.19.23.1 Into R-154, insert 0101. Verify and execute.

APOLLO G&N Specification
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 Original Issue Date:
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 Class A Release

POST INSTALLATION CHECKOUT PROCESS
 SPECIFICATION FOR THE APOLLO GUIDANCE
 AND NAVIGATION SYSTEM - BLOCK II

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
5/9/69	U	37563	90, 93, 128-131 <i>gfk/nc</i>	EA	RJJ

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- 6.2.14 Stabilization Loop Step Response Test
- 6.2.14.1 Proceed with this test if the Operate Power On Test of 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding.
- 6.2.14.2 Insure that the Carry-on Command Stimuli Unit, Model No. C14-200, is installed and connected.
- 6.2.14.3 Enter VERB 36 into K148. Press the ENTER pushbutton, then the ERROR RESET pushbutton.
- 6.2.14.4 Inner Gimbal Response Test
- 6.2.14.4.1 Enter code 2032000000 in C-START Module 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2117 IGA SERVO ERROR on 4A1-A3-CH1.
- 6.2.14.4.2 Enter VERB 41 NOUN 20 into K148. Press ENTER pushbutton.
- 6.2.14.4.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.
- 6.2.14.4.4 Enter VERB 42 into K148. Press ENTER.
- 6.2.14.4.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.
- 6.2.14.4.6 Deleted 01 into R154. Verify and execute to apply +28 VDC ACE ENABLE to the PCAAM.
- 6.2.14.4.7 Enter 1000 into R155. Verify and execute to enter a DC step into the IG stabilization loop.
- CAUTION: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.
- 6.2.14.4.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.
- 6.2.14.4.9 Enter 0000 into 4A2-A6-R155; the top part of switch should be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the IG Stabilization Loop. The bottom part of switch shall be extinguished.
- 6.2.14.4.10 After the transient has died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step input and the settling of the error signal to a value equal to ± 5 percent of the original step amplitude. In addition, record the total number of overshoots.

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- 6.2.14.7.2 Enter +00000 into K148. Press the ENTER pushbutton.
- 6.2.14.7.3 Enter +00000 into K148. Press the ENTER pushbutton.
- 6.2.14.7.4 Enter +00000 into K148. Press the ENTER pushbutton.



Figure 1. Typical Step Input Response

- 6.2.14.7.5 Deleted 00 into R154. Verify and execute to remove +28 VDC ACEENABLE.
- 6.2.15 IRIG Scale Factor Test
- 6.2.15.1 Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.15.2 Verify that the IMU OPERATE power has been applied for a minimum of 1 hour, and that at least 1 hour has elapsed since running of the Gimbal Friction Test, 6.2.7.
- 6.2.15.3 Set up the Analog Recorders to monitor the following signals:
- a. CG 2117 IG SERVO ERROR
 - b. CG 2147 MG SERVO ERROR
 - c. CG 2177 OG SERVO ERROR
 - d. CG 2120 IG TM CURRENT
 - e. CG 2150 MG TM CURRENT
 - f. CG 2180 OG TM CURRENT
- 6.2.15.3.1 Start the analog recorder chart drive using a chart speed of 1 mm/sec. The recorder shall run for the duration of 6.2.15.
- 6.2.15.4 Enter VERB 57 into K148. Press the ENTER pushbutton.
- 6.2.15.5 Enter 00005 into K148. Press the ENTER pushbutton. Program 07 shall be displayed.
- 6.2.15.6 VERB 06 NOUN 61 shall flash on CRT and the following displayed in R1 and R2:
- R1 = ±xxxxx (some Nav. Base azimuth)
- R2 = ±xxxxx (some test site latitude; see Table I)

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- 6.2.19.2 discernible lighting.
(cont)
- NOTE: The flashing indication of the CMC Power Supplies on CRT may be disregarded for this test. The charts in Table I may be used to determine approximate values for the "XX.X" values of C-156 voltage dial settings corresponding to various power supply voltages.
- 6.2.19.2.1 Into R-153, insert 1100. Verify and execute.
- 6.2.19.3 Units R-154, insert 0001. Verify and execute.
- 6.2.19.4 Insert in C-156, -010001244 and execute. Verify on CRT that GV0116 is between 0.0 and -2.0 vdc.
- 6.2.19.5 Insert in C-156 -015001234 and execute. Verify on CRT that GV0106 is between -0.5 and -2.5 vdc.
- 6.2.19.6 Units R-154, insert 0111. Verify and execute.
- 6.2.19.7 Observe CG 1020, +14 VDC Power Supply, and CG 1030, +4 VDC Power Supply on CRT. Repeat 6.2.19.3 through 6.2.19.6 adjusting each C Start entry until CG 1020 is 12.1, +0.1, -0.0 vdc and CG 1030 is 3.40, +0.03, -0.00 vdc.
- 6.2.19.8 Initiate CMC Self Check by inserting the following in K-148.
- a. ERROR RESET
 - b. VERB 21, NOUN 27, ENTER
 - c. 77777, ENTER
- Wait 200 seconds.
- 6.2.19.9 Insure that the DSKY RESTART lamp does not light, and that
- a. VERB 05 NOUN 31
 - b. R1 = 01102
- does not appear on DSKY.
- 6.2.19.9.1 Into R-154, insert 0101. Verify and execute.
- 6.2.19.10 Set INHIBIT VOLTAGE FAIL switch to OFF on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. If RESTART lamp does not light, repeat 6.2.19.3. Verify CMC Warning master alarms are lighted.

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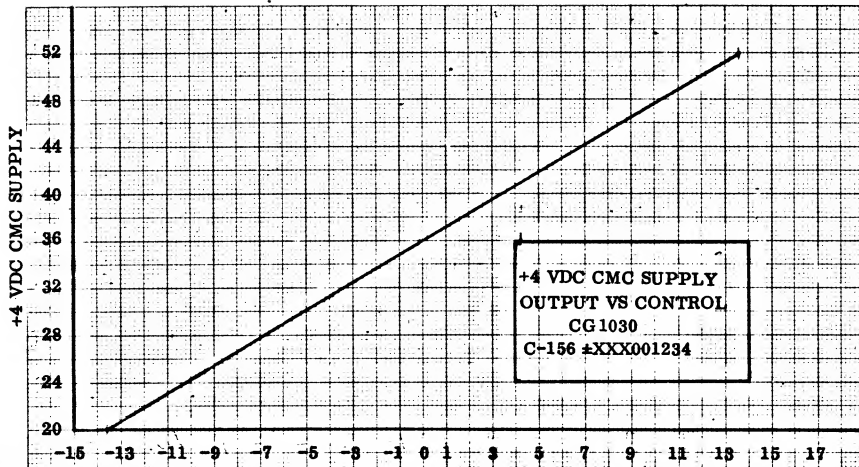
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- 6.2.19.11 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- ERROR RESET
 - VERB 21, NOUN 27, ENTER
 - 77777, ENTER
- 6.2.19.12 Units R-154, insert 0001. Verify and execute.
- 6.2.19.13 Insert in C-156 +084001244 and execute. Verify on CRT that GV0116 is between +7.4 and +9.4 vdc.
- 6.2.19.14 Units R-154, insert 0111. Verify and execute.
- 6.2.19.15 Observe CG 1020, +14 VDC Power Supply on CRT. Repeat 6.2.19.12 through 6.2.19.14 adjusting the C Start entry until CG 1020 is 16.4, +0.1, -0.0 vdc.
- 6.2.19.16 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- VERB 05, NOUN 31
 - R1 = 01102
- does not appear on DSKY
- 6.2.19.16.1 Into R-154, insert 0011. Verify and execute.
- 6.2.19.17 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted. *1. During 6.2.19.17, measuring the CG 1020 on the PSAAM interface instead of CRT.*
- 6.2.19.18 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- ERROR RESET
 - VERB 21, NOUN 27, ENTER
 - 77777, ENTER
- 6.2.19.19 Units R-154, insert 0001. Verify and execute.
- 6.2.19.20 Insert in C-156, +082001234 and execute. Verify on CRT that GV0106 is between +7.2 and +9.2 vdc.
- 6.2.19.21 Units R-154, insert 0111. Verify and execute.
- 6.2.19.22 Observe CG 1030, +4 VDC Power Supply on CRT. Repeat 6.2.19.19 through 6.2.19.21 adjusting the C Start entry until CG 1030 is 4.60, +0.08 -0.09 vdc.
- 6.2.19.23 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- VERB 05, NOUN 31
 - R1=01102
- does not appear on DSKY.
- 6.2.19.23.1 Into R-154, insert 0101. Verify and execute.

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- 6.2.19.24 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted. ~~CG 1020 through 6.2.19.24 measuring CG 1020 and CG 1030 at PSAAM interface instead of CRT.~~
- 6.2.19.25 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- ERROR RESET
 - VERB 21, NOUN 27, ENTER
 - 77777, ENTER.
- 6.2.19.26 Units R-154, insert 0001. Verify and execute.
- 6.2.19.27 Insert in C-156, -010001244 and execute. Verify on CRT that GV0116 is between 0.0 and -2.0 vdc.
- 6.2.19.28 Units R-154, insert 0111. Verify and execute.
- 6.2.19.29 Observe CG 1020, +14 VDC Power Supply on CRT. Repeat 6.2.19.26 through 6.2.19.28 adjusting the C Start entry until CG 1020 is 12.1, +0.1, -0.0 vdc.
- 6.2.19.30 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- VERB 05, NOUN 31
 - R1 = 01102
- does not appear on DSKY.
- 6.2.19.30.1 Into R-154, insert 0011. Verify and execute.
- 6.2.19.31 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted. ~~CG 1020 through 6.2.19.31 measuring CG 1020 and CG 1030 at PSAAM interface instead of CRT.~~
- 6.2.19.32 Units R-154, insert 0000. Verify and execute.
- 6.2.19.33 Terminate CMC Self-Check by inserting into K-148:
- ERROR RESET
 - VERB 21, NOUN 27, ENTER
 - 00000, ENTER
- 6.2.19.34 Ensure that CG 1020, +14 VDC Power Supply indication is +14.0, ± 0.4 ; and that CG 1030, +4 VDC Power Supply indication is +4.00 ± 0.20 VDC on CRT.



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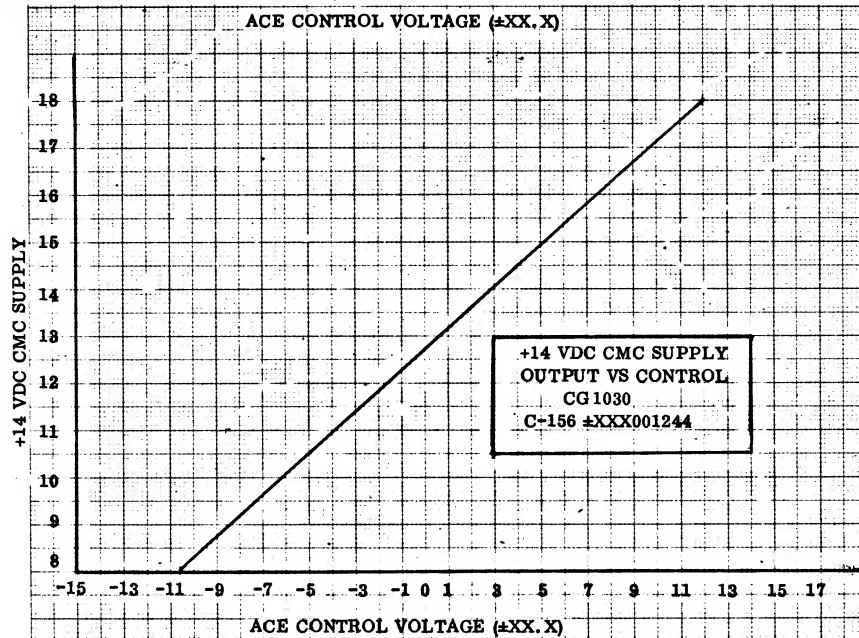


TABLE I

APOLLO G&N Specification
 ND1002325 REV V
 Original Issue Date:
 Release Authority: TDRR 31414
 Class A Release

POST INSTALLATION CHECKOUT PROCESS
 SPECIFICATION FOR THE APOLLO GUIDANCE
 AND NAVIGATION SYSTEM - BLOCK II

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
5/9/69	U	37563	90, 93, 128-131 <i>DRS/AC</i>	EA	RJJ
10/1/69	V	37863	25, 26 <i>DRS/AC</i>	EA	MDH

APPROVALS	Not required per CCA-497- 0274	MIT/IL	R. D. Petryk	D. A. Ziemer
	NASA/MSC		AC	

6.2 Test Procedures

6.2.1 Application of Standby Power to G&N System

- 6.2.1.1 Verify that spacecraft power checks, to include polarity and magnitude on Spacecraft Power Connector, have been made as specified in 6.1.3.
- 6.2.1.2 All power and control switches on the G&N Indicator Control Panel shall be placed in the OFF or neutral position.
- 6.2.1.3 The Inertial Component Temperature Controller (ICTC) shall be supplying inertial component heater power to the G&N System through the PSA, Connector No. 45J2.
- 6.2.1.4 Computer Power On
- 6.2.1.4.1 Set G&N COMPUTER MN A and MN B Breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in).
- NOTE: Restart Lamp may illuminate, if it does, disregard and press RSET on the DSKY.
- 6.2.1.4.2 Set the POWER-AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in), and position G/N POWER switch to AC1.
- 6.2.1.4.3 Set the computer numerical display lights to the minimum acceptable brightness by rotating the BRIGHTNESS Controls on the MDC and LEB Lighting Control Panels.
- 6.2.1.4.4 The +28 VDC CMC OPERATE voltage (CG 1520) shall be +28.8±3 VDC. Verify CRT indication. On the G&N Indicator Control Panel verify PGNS light is ON.

6.2.1.4.4.1 Enter the following into K-148:

```
VERB 21 NOUN 01  ENTR
03700           ENTR
33663           ENTR
NOUN 15         ENTR
55426           ENTR ENTR
04064           ENTR ENTR
15374           ENTR
VERB 25 NOUN 26  ENTR
20000           ENTR
01700           ENTR
12007           ENTR
VERB 30         ENTR
```

On the DSKY verify TEMP light is ON.

- 6.2.1.4.5 Using DSKY, enter VERB 36, ENTR, then press RESET. Verify that R1, R2 and R3 are blank and PROG = 00.
- 6.2.1.4.6 The voltage output of the +4 VDC CMC supply shall be $+4.00 \pm 0.20$ VDC (CG 1030). The value on the CRT shall be recorded.
- 6.2.1.4.7 The voltage output of the +14 VDC CMC supply shall be $+14.0 \pm 0.4$ VDC, (CG 1020). The value on the CRT shall be recorded.
- 6.2.1.4.8 Verify that the CMC is in the Backup Mode by monitoring on the CRT that the Program indicates 00, and the Program readouts on the MDC and LEB AGC DSKY indicate 00.
- 6.2.1.4.9 Deleted.
- 6.2.1.4.10 Initiate CMC self-check by entering the following sequence into the K-start:
 - a. VERB 21, NOUN 27 ENTER
 - b. 77777, ENTER
 - c. VERB 15 NOUN 01 ENTER
 - d. 1366, ENTER
- 6.2.1.4.10.1 Monitor DSKY until R3 (SCOUNT+2) increments twice. If an error is detected, the following will be displayed:
 - a. VERB 05 NOUN 31
 - b. R1 = 01102
 - c. R2 = XXXXX C (SFAIL)
 - d. R3 = XXXXX C (ERCOUNT)
- 6.2.1.4.10.2 Terminate the monitor routine by entering the following into the DSKY:

VERB 34, ENTER.
- 6.2.1.4.10.3 Enter the following into the K-start:
 - a. VERB 21
 - b. NOUN 27, press ENTER pushbutton
 - c. 00000, press ENTER pushbutton

APOLLO G&N Specification
 ND1002325 REV W
 Original Issue Date:
 Release Authority: TDRR 31414
 Class A Release

POST INSTALLATION CHECKOUT PROCESS
 SPECIFICATION FOR THE APOLLO GUIDANCE
 AND NAVIGATION SYSTEM - BLOCK II

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
5/9/69	U	37563	90, 93, 128-131 <i>RLH/AC</i>	EA	RJJ
10/1/69	V	37863	25, 26 <i>RLH/AC</i>	EA	MDH
10/15/69	W	37886	74-167, was 167 pages, now 168 pages. <i>RLH/AC</i>	EA	MDH

APPROVALS	Not required per CCA-497-0274	MIT/IL	R. D. Petryk	D. A. Ziemer
	NASA/MSC		AC	

- 6.2.9.27.2.1 Perform the following on the DSKY.

VERB 21 NOUN 10 ENTR
00012 ENTR
00001 ENTR

Observe: Tracker fail and PGNS warning lamps on.

- 6.2.9.27.2.2 Perform the following on the DSKY.

VERB 21 NOUN 10 ENTR
00012 ENTR
00000 ENTR

Depress Error Reset and observe the Tracker fail and PGNS warning lamps off.

- 6.2.9.27.3 Using the Optics Hand Controller, drive the Optics Shaft until the shaft TPAC Indicates 0.00 degree and drive the Optics Trunnion until the trunnion TPAC indicates 0.75 degree.

- 6.2.9.27.3.1 Perform the following on the DSKY.

VERB 21 NOUN 10 ENTR
00012 ENTR
00001 ENTR

Observe: Tracker fail and PGNS warning lamps on.

- 6.2.9.27.3.2 Perform the following on the DSKY.

VERB 21 NOUN 10 ENTR
00012 ENTR
00000 ENTR

Depress Error Reset.

- 6.2.9.28 Computer Manual Mode Optics Drive

NOTE: Perform the following procedure only if GNIC panel P/N 2021290-51 is installed in the spacecraft.

- 6.2.9.28.1 Set the OPTICS ZERO switch on the Indicator Control Panel to ZERO and the OPTICS MODE switch to MANUAL.

- 6.2.9.28.2 Perform the following on the DSKY.

VERB 24 NOUN 01 ENTR
00053 ENTR
00377 ENTR
00377 ENTR
VERB 21 NOUN 10 ENTR
00012 ENTR
00002 ENTR/ENTR
00014 ENTR
06000 ENTR

- 6.2.9.28.3 Set the OPTICS ZERO switch on the Indicator Control Panel to OFF.

6.2.9.28.4

Verify on the TPAC:

Shaft Angle = $11.15^{\circ} \pm 0.11^{\circ}$
Trunnion Angle = $2.79^{\circ} \pm 0.22^{\circ}$

6.2.9.28.5

Perform the following on the DSKY.

VERB 21 NOUN 01 ENTR
00012 ENTR
00000 ENTR

6.2.9.28.6

Set the G/N Power - Optics switch on the LEM lighting control panel to OFF.

6.2.10

Zero Optics Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 Turn On procedure before proceeding.

INITIALIZATION

6.2.10.1

Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $+28.0 \pm 3.0$ VDC. Verify that the OPTIX 28V 800 cps 1% zero (CG 1211) and OPTIX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.10.2

Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.

- a. VERB 41 NOUN 20 ENTR
- b. +00000, ENTR
- c. +00000, ENTR
- d. +00000, ENTR

6.2.10.3

Insure that the following switches on the G&N Indicator Control Panel are set as follows:

- a. OPTICS TEL TRUN to SLAVE TO SXT
- b. OPTICS COUPLING to DIRECT

6.2.10.3
(Cont)

- c. OPTICS SPEED to HI
- d. OPTICS MODE to MAN

OPTICS ZERO MODE TEST

6.2.10.4

Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K-148. Press the ENTER pushbutton.

6.2.10.5

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following on R1 and R2 of the DSKY.

- a. $R1 = +0.00^{\circ} +0.02^{\circ}, -0.03^{\circ}$ (Shaft Angle)
- b. $R2 = +0.000^{\circ} +0.006^{\circ}, -0.007^{\circ}$ (Trunnion Los Angle)

Record the TPAC Indications. The Shaft Angle shall be 0.0 ± 0.11 degrees. The Trunnion Angle shall be 0.0 ± 0.22 degrees.

6.2.10.5.1

Enter the following:

VERB 01 NOUN 10, ENTER
00033, ENTER
Verify R1 = XXX6X

6.2.10.5.2

Return the OPTICS ZERO switch to OFF. Set the OPTICS MODE switch to CMC. Enter the following:

ENTER
00033, ENTER
Verify R1 = XXX5X

6.2.10.5.3

Set the OPTICS MODE switch to MAN. Press the KEY REL pushbutton on the DSKY.

OPTICS TIME TO ZERO TESTS

6.2.10.6

Deleted.

6.2.10.7

Deleted.

6.2.10.8

Deleted.

6.2.10.9

Deleted.

6.2.10.10

Deleted.

6.2.10.11

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- 6.2.10.12 Set the OPTICS ZERO switch on the G&N Indicator Control Panel to OFF. Set the G&N Power Optics Switch on the LEB Lighting Control Panel to OFF.

OPTICS BACKUP MODE TEST

- 6.2.10.13 Insert the inflight tool (V36601405) into the Trunnion Tool input and engage drive mechanism (button out). Verify that the trunnion turns by viewing the movement through the SCT eyepiece while turning the tool until the TPAC reads +5 deg. Remove the tool from the trunnion tool input.
- 6.2.10.14 Insert the inflight tool (V36601405) into the Shaft Tool input and engage the drive mechanism (button out). Verify that the Shaft turns by viewing the movement through the SCT eyepiece while turning the tool so that the shaft moves through an angle from 0° to +3° to 0 as indicated on the shaft TPAC. Disengage the shaft drive mechanism (button in) and remove the tool.
- 6.2.10.15 Insert the inflight tool (V36601405) into the Trunnion Tool input. Verify that the Trunnion turns by viewing the movement through the SCT eyepiece while turning the tool so that the trunnion moves from +5° to -5° and back to zero as indicated on the Trunnion TPAC. Disengage the trunnion drive mechanism (button in) and remove the tool.

6.2.11 OPTICS Coordinate Transformation Control Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding.

INITIALIZATION

- 6.2.11.1 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±0.3 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.
- 6.2.11.2 Enter the following into the K-Start. Press the ENTER pushbutton after each entry.
- a. VERB 41 NOUN 20, ENTER
 - b. +00000, ENTER
 - c. +00000, ENTER
 - d. +00000, ENTER
- 6.2.11.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the position indicated.
- a. OPTICS TEL TRUN to SLAVE to SXT
 - b. OPTICS COUPLING to DIRECT

- c. OPTICS SPEED to HI
- d. OPTICS MODE to MAN

6.2.11.4 Set up the analog recorders to monitor the following measurements:

- a. CG 3170 SCT Trunnion Tachometer Output

6.2.11.5 Enter the following into the K-Start to monitor the OPTICS CDU's.

VERB 16 NOUN 55, press ENTER

6.2.11.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the G&N Panel to ZERO. Wait 15 seconds. Return the OPTICS ZERO switch to OFF.

RESOLVED MODE PHASING AND IMAGE RATE TEST

6.2.11.7 Using the OPTICS CONTROL STICK, drive the Optics until $R1 = +225.00$ and $R2 = +10.000$ on the CRT and the DSKY's.

6.2.11.8 Set the OPTICS COUPLING switch on the G&N Panel to RSLV and controller speed switch to MED.

6.2.11.9 Position the movable optics target such that it is centered on the SCT retical pattern, then start the analog recorders.

6.2.11.10 Quickly displace the OPTICS CONTROL STICK 45 ± 10 degrees in the upper right hand quadrant while sighting on the optics target through the SCT eyepiece. The target shall appear to move in the upper right field of view of the SCT at 45 ± 10 deg. When target leaves the SCT upper right field of view press MARK pushbutton and immediately record the shaft angle as displayed on R1 of the DSKY. The recorded shaft angle shall be $+225 \pm 10.00$ degrees.

6.2.11.11 Stop the analog recorder and measure the elapsed time between the initial and the final signal null conditions for the trunnion measurement. The elapsed time shall be +19 to +32 seconds.

CSC AMPLIFIER SHAFT AND TRUNNION DRIVE TEST

6.2.11.12 Set the OPTICS COUPLING switch to DIRECT. Again using the OPTICS CONTROL STICK, drive the optics until $R1 = +225.00$ and $R2 = +10.000$. Set the OPTICS COUPLING switch to RSLV.

6.2.11.13 While sighting on the optical target through the SCT eyepiece displace the OPTICS CONTROL STICK fully to the right. Verify that the target image appears to move in a straight line horizontally to the right and release the OPTICS CONTROL STICK when the target image reaches the edge of the SCT field of view.

6.2.11.14 Enter VERB 34 in the DSKY.
Press the ENTER pushbutton.

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6.2.11.15 Set the OPTICS COUPLING switch on the G&N Panel to DIRECT. Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion Slave to SXT). Set the OPTICS ZERO switch to ZERO.

NOTE: If Optics testing will continue, set the G/N POWER OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.12 Optics Functional Test

Proceed with this test if 6.2.3 Operate Power On Test, or 6.2.5.2, Turn-On Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2, Turn On Procedure, before proceeding.

NOTE: This test requires the use of the G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT StLOS before proceeding. Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.

6.2.12.1 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Set Tracker switch to OFF. Verify the following:

- +28 VDC OPTX OPERATE BUS (CG 1530) is 28.8±3 VDC. Record the indication on the CRT.
- CG 1211 OPTX 28V 800 cps 1% 0 ph not flashing on CRT.
- CG 1212 OPTX 800 cps 5% - 90 ph not flashing on CRT.

6.2.12.2 Enter the following sequence into the K-Start.

- VERB 41, NOUN 20, ENTER
- +00000, ENTER
- +00000, ENTER
- +00000, ENTER

6.2.12.3 Insure that Optics Control switches on the G&N Indicator Control Panel are set as follows:

- OPTICS ZERO to OFF
- OPTICS MODE to MAN
- OPTICS SPEED to LO
- OPTICS COUPLING to DIRECT
- OPTICS TEL TRUN to SLAVE to SXT

- 6.2.12.4 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. After 15 seconds return the switch to OFF.
- 6.2.12.5 Resolution Checks
- 6.2.12.5.1 Sight through the SXT eyepiece. Using the OPTICS CONTROL STICK, adjust the SXT to obtain the best reflected field of view of the 5-inch autocollimator reticle engravings at the center of the field of view.
- 6.2.12.5.2 Note that the autocollimator reticle contains a series of lines of different thickness and width. Each set of lines is marked with a number (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines. The SXT resolution shall be at least 10 arc-seconds at the center of the field of view.
- 6.2.12.5.3 Repeat 6.2.12.5.1 and 6.2.12.5.2 using the SCT and the SCT resolution chart. The SCT shall have a resolution of at least 3 arc-minutes at the center of the field of view.
- 6.2.12.6 Slave Telescope Mode Checks
- 6.2.12.6.1 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.6.2 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the Control Indicator Panel to ZERO. Wait 15 seconds
- 6.2.12.6.3 Record the SCT Shaft and Trunnion angles as indicated by the TPAC and the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between the TPAC Shaft angle and the Shaft CDU angle shall be ± 0.11 degree or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be ± 0.22 degree or less.
- 6.2.12.6.4 Place the OPTICS ZERO switch to OFF. Using the OPTICS CONTROL STICK drive the SXT Shaft and Trunnion CDU's until $R1 = +035.00 \pm 0.10$ degree and $R2 = 35.000 \pm 0.100$ degree, setting the CONTROLLER SPEED switch to LO, as the angles are approached. Press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles as indicated by the TPAC. Record R1 and R2. The difference between the TPAC Shaft angle and the Shaft CDU angle shall be ± 0.11 deg or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be ± 0.22 deg or less.

- 6.2.12.6.5 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO.
- 6.2.12.6.6 Set the OPTICS TEL TRUN switch to SLAVE to SXT position.
- 6.2.12.6.7 Remove the plug from the base of the SXT eyepiece and install the Adapter Assembly and Portable Light Assembly. Turn on the light.
- NOTE: If needed to reduce external light, place a photographer's hood over the optics head and retroreflecting prism.
- 6.2.12.6.8 Sight through the SCT eyepiece and provide direction to personnel outside spacecraft for positioning the Retroreflecting Prism, Model No. A23-200, to span between the SXT LLOS and SCT LOS such that the illumination from the back-light filament is clearly visible at the center of the field of view. Prism must be held in this alignment position until completion of Step 6.2.12.6.11.
- 6.2.12.6.9 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Note the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement, expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. For instance, the outer ends of the SXT reticle lines are 6% from center. Displacement shall be less than 50% (bar must be closer to center than to edge of field of view).
- 6.2.12.6.10 Set the OPTICS TEL TRUN switch to 0° position.
- 6.2.12.6.11 Again direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in Step 6.2.12.6.9. Place the OPTICS MODE switch to MAN and observe the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. Displacement shall be less than 50%.
- 6.2.12.6.12 Remove the Retroreflecting Prism.
- 6.2.12.6.13 Replace the Portable Light in the adapter on the SXT eyepiece.
- 6.2.12.6.14 While sighting into the SCT eyepiece, set the OPTICS TEL TRUN switch to 25 deg. and observe that the resolution pattern mounted outside the spacecraft appears to move downward from the center of the field of view to the zero reticle marking that is 25 deg. below the center of the field of view.
- 6.2.12.6.15 Record the TPAC Trunnion Angle. It shall be $25.00^\circ \pm 1.0^\circ$.

- 6.2.12.6.16 Set the OPTICS TEL TRUN switch to SLAVE TO SXT. Set the OPTICS ZERO switch to OFF.
- 6.2.12.7 SXT Parallelism Tests
- 6.2.12.7.1 Using the OPTICS CONTROL STICK drive the SXT StLOS Trunnion to $+15.000 \pm 2$ degree as indicated in R2 of the DSKY. Maintain a Shaft CDU angle of 000.00 ± 0.10 degree as indicated by R1 on the DSKY.
- 6.2.12.7.2 Sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to superimpose the SXT LLOS horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.
- 6.2.12.7.3 Repeat 6.2.12.7.2 twice. Calculate and record the average of the three autocollimator readings.
- 6.2.12.7.4 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within $+5$ degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO.
- 6.2.12.7.5 Again sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to bring the SXT StLOS horizontal reticle and autocollimator horizontal filar images to coincide. Record the autocollimator reading.
- 6.2.12.7.6 Repeat 6.2.12.7.5 twice. Calculate and record the average of the three autocollimator readings. The average value obtained here shall not differ from that obtained in 6.2.12.7.3 by more than 10 arc-seconds.
- 6.2.12.7.7 Deleted.
- 6.2.12.7.8 Deleted.
- 6.2.12.7.9 Remove the Portable Light Assembly and Adapter Assembly from the base of the SXT eyepiece. Replace the SXT eyepiece plug.
- NOTE: If Optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.
- 6.2.12.8 Shaft and Trunnion Positional Accuracy Checks
- 6.2.12.8.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within $+5$ degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. After 15 seconds, return the selector to OFF.
- 6.2.12.8.2 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton.

- 6.2.12.8.3 Sight through the SXT. Using the control stick align the SXT SLOS with optical target No. 1 on the G&N Installation Fixture Model No. A23-097. Set the OPTICS SPEED switch to LO as the target is approached. When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.
- 6.2.12.8.4 Sight through the SXT. Using the control stick align the SXT SLOS with optical target No. 2 on A23-097. Set the OPTICS SPEED switch to LO as the target is approached.
- 6.2.12.8.5 When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.
- 6.2.12.8.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. After 15 seconds set the switch to OFF. Set the OPTICS MODE switch to CMC.
- 6.2.12.8.7 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.8 Enter the value recorded from R1 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.9 Enter the value recorded from R2 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.10 Sight through the SXT. The SLOS should be centered on Optical Target No. 1 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.3 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.11 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.12 Enter the value recorded from R1 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.13 Enter the value recorded from R2 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.14 Sight through the SXT. The SLOS should be centered on Optical Target No. 2 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.5 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.15 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. After 15 seconds return the switch to OFF.

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- 6.2.12.8.16 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start 3 times. Press the ENTER pushbutton after each entry.
- 6.2.13 Optics Slew Rate Test
- NOTE: Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.13.1 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.
- 6.2.13.2 Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.
- VERB 41 NOUN 20, ENTER
 - +00000, ENTER
 - +00000, ENTER
 - +00000, ENTER
- 6.2.13.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the positions indicated.
- TEL TRUN to SLAVE to SXT
 - OPTICS COUPLING to DIRECT
 - OPTICS SPEED to HI
 - OPTICS MODE to MAN
- 6.2.13.4 Monitor MARK COMMAND by entering VERB 06 NOUN 56 into K-148. Press the ENTER pushbutton.
- TRUNNION SLEW RATE - HI SPEED
- 6.2.13.5 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees to zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch on the G&N Indicator Control Panel to OFF.
- NOTE: Read and understand step 6.2.13.6 before proceeding. Do not hold Control Stick at upper limit more than 10 seconds, or exceed a trunnion angle of 85 degrees.
- 6.2.13.6 While slewing the optics, record the following signals: SXT TRUN SERVO error (CG 3118), SXT TRUN TACH (CG 3150), and SXT TRUN TACH (CG 3170). CG 3118 shall be between -0.25 and -2.0 VRMS. ~~CG 3150 shall be between -0.25 and -2.0 VRMS.~~ CG 3150 shall be 2.3±1.3 VRMS. CG 3170 shall be -0.85±0.35 VRMS.

6.2.13.6
(Continued)

Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds.

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(before display changes). The data displayed is in the following form:

- $R2 = \pm XX.XXX$ (Trunnion LOS angle in deg)
- $R3 = +XXX.XX$ (Time in seconds)

After the display has changed, again record the value of R2 and R3.

6.2.13.7

Perform the following calculations:

NOTE: In performing calculation b. below, and in similar calculations throughout this test procedure, the following shall be noted and taken into account. It is possible that the second R3 reading may be smaller than the first reading. If so, add an overflow time value of 163.84 sec to the second reading and then subtract the first reading, in order to obtain Δ time as the difference of the two R3 readings.

- Difference between R2 displays = _____ (Δ trun. angle)
- Difference between R3 displays = _____ (Δ time)
- $\frac{\Delta \text{ trun. angle}}{\Delta \text{ time}} = \text{---}^\circ \text{---} \text{ deg/sec}$

The trunnion slew rate shall be 10 ± 2 deg/sec.

SHAFT SLEW RATE - HI SPEED

6.2.13.8

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand step 6.2.13.9 before proceeding. Do not hold Control Stick at right limit for more than 10 seconds, or exceed a shaft angle of 250 degrees.

6.2.13.9

While slewing the optics, record the following signals: SXT SHAFT SERVO error (CG 3117), SXT SHAFT TACH (CG 3140), and SCT SHAFT TACH (CG3160). CG 3117 shall be between -0.2 and -2.0 VRMS. CG 3140 shall be 3.3 ± 1.3 VRMS. CG 3160 shall be -3.3 ± 1.3 VRMS. Push and hold the Optics Control stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 sec (before display changes). The data displayed is in the following form:

- $R1 = \pm XXX.XX$ (Shaft angles in deg.)
- $R3 = +XXX.XX$ (Time in seconds.)

After the display has changed, again record the values of R1 and R3.

6.2.13.10

Perform the following calculations:

- a. Difference between R1 displays = ____ * ____ (Δ shaft angle)
- b. Difference between R3 displays = ____ * ____ (Δ time)
- c. $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{---} \cdot \text{---} \text{ deg/sec}$

The Shaft Slew Rate shall be $19.5 \pm 3.9 \text{ deg/sec}$
TRUNNION SLEW RATE - MED SPEED

6.2.13.11

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Set the OPTICS SPEED switch to MED. Monitor MARK command by entering VERB 06 NOUN 56 in K148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.12 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

6.2.13.12

Record the SXT TRUN MTR control winding (CG 3155) signal on the CRT while slewing the optics. CG 3155 shall be +0.25 to +2.00 VRMS. Push and hold the Optics Control Stick to its upper limit.

Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R2 = ±XX.XXX (Trunnion LOS angle in deg)
- b. R3 = +XXX.XX (Time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.13

Perform the following calculations:

- a. Difference between R2 displays = ____ * ____ (Δ trunnion angle)
- b. Difference between R3 displays = ____ * ____ (Δ time)
- c. $\frac{\Delta \text{trunnion angle}}{\Delta \text{time}} = \text{---} \cdot \text{---} \text{ deg/sec}$

The Trunnion Slew Rate shall be $1.0 \pm 0.2 \text{ deg/sec}$.

SHAFT SLEW RATE - MED SPEED .

6.2.13.14

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to MAN. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.15 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.15

Record the SXT SHAFT MTR control winding (CG 3145) signal on the CRT while slewing the optics. CG 3145 shall be +0.50 to +4.0 VRMS. Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R1 = ±XXX.XX (Shaft angles in deg)
- b. R3 = +XXX.XX (Time in seconds)

After the display has changed, again record the values of R1 and R3.

6.2.13.16

Perform the following calculations:

- a. Difference between R1 displays = ____ . ____ (Δ shaft angle)
- b. Difference between R3 displays = ____ . ____ (Δ time)
- c. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \text{---} \cdot \text{---} \text{ deg/sec}$

The Shaft Slew Rate shall be $2.0 \pm 0.4 \text{ deg/sec}$.

TRUNNION SLEW RATE - LO SPEED

6.2.13.17

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Set the OPTICS SPEED switch to LO. Monitor MARK command by entering the VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.18 before proceeding. Do not hold control stick at upper limit for more than 30 seconds.

6.2.13.18

Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 sec (before display changes). The data displayed is in the following form:

- a. $R2 = \pm XX.XXX$ (Trunnion LOS angle in deg)
- b. $R3 = +XXX.XX$ (Time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.19

Perform the following calculations:

- a. Difference between R2 displays = $\text{---} \cdot \text{---}$ (Δ trunnion angle)
- b. Difference between R3 displays = $\text{---} \cdot \text{---}$ (Δ time)
- c. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}} = \text{---} \cdot \text{---}$ deg/sec.

The Trunnion Slew Rate shall be 0.10 ± 0.02 deg/sec.

SHAFT SLEW RATE - LO SPEED

6.2.13.20

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Monitor MARK command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.21 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.21

Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 sec (before display changes). The data displayed is in the following form:

- a. $R1 = \pm XXX.XX$ (Shaft angle in deg)
- b. $R3 = +XXX.XX$ (Time in seconds)

After the display has changed, again record the values of R1 and R3.

6.2.13.22

Perform the following calculations:

- a. Difference between R1 displays = $\text{---} \cdot \text{---}$ (Δ shaft angle)
- b. Difference between R3 displays = $\text{---} \cdot \text{---}$ (Δ time)
- c. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \text{---} \cdot \text{---}$ deg/sec

The Shaft Slew Rate shall be 0.20 ± 0.04 deg/sec.

OPTICS HAND CONTROLLER DRIFT RATE CHECK - LO SPEED

- 6.2.13.23 On K-148, enter VERB 06 NOUN 56 ENTER. Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF.
- 6.2.13.24 Press and release MARK pushbutton. Approximately 60 seconds after the first MARK, again press and release MARK pushbutton. Verify KEY RELEASE is flashing. Press KEY RELEASE pushbutton and record data in R1, R2 and R3 within 2 seconds. When DSKY display changes, again record R1, R2 and R3. The data display is in the following form:
- a. R1 = ±XXX.XX (Shaft Angle in Degrees)
 - b. R2 = ±XX.XXX (Trunnion Angle in Degrees)
 - c. R3 = +XXX.XX (Time in Seconds)
- 6.2.13.25 Perform the following calculations (first display minus second display):
- a. Difference between R1 displays = _____ (Δ shaft angle)
 - b. Difference between R2 displays = _____ (Δ trunnion angles)
 - c. Difference between R3 displays = _____ (Δ time)
 - d. $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{_____ deg/sec (shaft drift rate)}$
shall be less than 0.0333 deg/sec.
 - e. $\frac{\Delta \text{trunnion angle}}{\Delta \text{time}} = \text{_____ deg/sec (trunnion drift rate)}$
shall be less than 0.0167 deg/sec.
- 6.2.13.26 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

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- 6.2.14 Stabilization Loop Step Response Test
- 6.2.14.1 Proceed with this test if the Operate Power On Test of 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding.
- 6.2.14.2 Insure that the Carry-on Command Stimuli Unit, Model No. C14-200, is installed and connected.
- 6.2.14.3 Enter VERB 36 into K148. Press the ENTER pushbutton, then the ERROR RESET pushbutton.
- 6.2.14.4 Inner Gimbal Response Test
- 6.2.14.4.1 Enter code 2032000000 in C-START Module 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2117 IGA SERVO ERROR on 4A1-A3-CH1.
- 6.2.14.4.2 Enter VERB 41 NOUN 20 into K148. Press ENTER pushbutton.
- 6.2.14.4.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.
- 6.2.14.4.4 Enter VERB 42 into K148. Press ENTER.
- 6.2.14.4.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.
- 6.2.14.4.6 Deleted.
- 6.2.14.4.7 Enter 1000 into R155. Verify and execute to enter a DC step into the IG stabilization loop.
- CAUTION: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.
- 6.2.14.4.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.
- 6.2.14.4.9 Enter 0000 into 4A2-A6-R155; the top part of switch should be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the IG Stabilization Loop. The bottom part of switch shall be extinguished.
- 6.2.14.4.10 After the transient has died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step input and the settling of the error signal to a value equal to ± 5 percent of the original step amplitude. In addition, record the total number of overshoots.

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- 6.2.14.4.10:1 The inner gimbal stabilization loop response time shall be less than 0.1 second.
- 6.2.14.4.10.2 The maximum number of overshoots on the IGA Servo Error signals shall be three.
- 6.2.14.5 Middle Gimbal Response Test
- 6.2.14.5.1 Enter code 2028000000 into C-START MODULE 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2147 MGA SERVO ERROR on 4A1-A3-CH1.
- 6.2.14.5.2 Enter VERB 41 NOUN 20 into K148. Press ENTER.
- 6.2.14.5.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.
- 6.2.14.5.4 Enter VERB 42 into K148. Press ENTER.
- 6.2.14.5.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.
- 6.2.14.5.6 Enter 0100 into 4A2-A6-R155. The top part of switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.
- 6.2.14.5.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the MG Stabilization Loop.
- CAUTION: If the transient caused by the step input does not die within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.
- 6.2.14.5.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.
- 6.2.14.5.9 Enter 0000 into 4A2-A6-R155. The top part of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press XEQ/SEAL pushbutton to remove the step input to the MG stabilization loop.
- 6.2.14.5.10 After the transients have died out, stop the analog recorder. Record the stab loop response time by measuring the time interval between removing the step input and the settling of the error signals to a value equal to 65 percent of the original step amplitude. In addition, record the total number of overshoots.
- 6.2.14.5.10.1 The middle gimbal stabilization loop response time shall be less than 0.1 second.
- 6.2.14.5.10.2 The maximum number of overshoots on the MGA Servo Error signals shall be three.

- 6.2.14.6 Outer Gimbal Response Test
- 6.2.14.6.1 Enter code 2026000000 in C-START Module 4A1-A5-C156. Press XEQ/SEAL Pushbutton to call up CG 2177 OGA SERVO ERROR on 4A1-A3-CH1.
- 6.2.14.6.2 Enter VERB 41 NOUN 20 into K148. Press ENTER.
- 6.2.14.6.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.
- 6.2.14.6.4 Enter VERB 42 into K148. Press ENTER pushbutton.
- 6.2.14.6.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.
- 6.2.14.6.6 Enter 0010 into 4A2-A6-R155. The top half of the switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.
- 6.2.14.6.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the OG Stabilization Loops.
- NOTE: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.
- 6.2.14.6.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.
- 6.2.14.6.9 Enter 0000 into 4A2-A6-R155. The top half of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the OG Stabilization Loop.
- 6.2.14.6.10 After the transients have died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step input and the settling of the error signal to a value equal to ± 5 percent of the original step amplitude. In addition, record the total number of overshoots.
- 6.2.14.6.10.1 The outer gimbal stabilization loop response time shall be less than 0.1 second.
- 6.2.14.6.10.2 The maximum number of overshoots on the OGA Servo Error Signals shall be five.
- 6.2.14.7 Enter VERB 40 NOUN 20 into K148. Press the ENTER pushbutton.
- 6.2.14.7.1 Enter VERB 41 NOUN 20 into K148. Press the ENTER pushbutton.

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6.2.14.7.2 Enter +00000 into K148. Press the ENTER pushbutton.

6.2.14.7.3 Enter +00000 into K148. Press the ENTER pushbutton.

6.2.14.7.4 Enter +00000 into K148. Press the ENTER pushbutton.



Figure 1: Typical Step Input Response.

6.2.14.7.5 Deleted.

6.2.15 IRIG Scale Factor Test

6.2.15.1 Perform Master Initialization 6.2.5.3 before proceeding.

6.2.15.2 Verify that the IMU OPERATE power has been applied for a minimum of 1 hour, and that at least 1 hour has elapsed since running of the Gimbal Friction Test, 6.2.7.

6.2.15.3 Set up the Analog Recorders to monitor the following signals:

- a. CG 2117 IG SERVO ERROR
- b. CG 2147 MG SERVO ERROR
- c. CG 2177 OG SERVO ERROR
- d. CG 2120 IG TM CURRENT
- e. CG 2150 MG TM CURRENT
- f. CG 2180 OG TM CURRENT

6.2.15.3.1 Start the analog recorder chart drive using a chart speed of 1 mm/sec. The recorder shall run for the duration of 6.2.15.

6.2.15.4 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.15.5 Enter 00005 into K148. Press the ENTER pushbutton. Program 07 shall be displayed.

6.2.15.6 VERB 06 NOUN 61 shall flash on CRT and the following displayed in R1 and R2:

R1 = xxxxxx (some Nav. Base azimuth)

R2 = xxxxxx (some test site latitude; see Table I)

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- 6.2.15.7 If the values displayed in R1 and R2 are correct, proceed with test, if not perform the following sequence:
- To correct R1, on the K-start enter VERB 21, press ENTER pushbutton, ±xxx.xx, press ENTER (±xxx.xx is correct nav. base azimuth).
 - To correct R2, on the K-start enter VERB 22, press ENTER pushbutton, ±xx.xxx, press ENTER (obtain correct site latitude from Table I).
- Verify values in R1 and R2 are correct.

Table I

<u>Site</u>	<u>Latitude</u>
NAA	+33.921
MSC	+29.556
MILA	+28.516

- 6.2.15.8 On K-148 enter the following sequence:
- VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
+00001 ENTR
- NOTE: If PROG lamp changes from 07 to 00 during next step or PROG ALARM is on, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.8.
- 6.2.15.9 In approximately 160 seconds VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (+X IRIG Scale Factor error in part per million, Position +00001).
- 6.2.15.10 On K-148 enter the following sequence:
- VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
+00002 ENTR
- NOTE: If PROG lamp changes from 07 to 00 during next step or PROG ALARM lamp is on, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.7 and 6.2.15.10.
- 6.2.15.11 In approximately 160 seconds VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (+Y IRIG Scale Factor error in parts per million Position +00002).
- 6.2.15.12 On K-148 enter the following sequence:
- VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
+00003 ENTR
- NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM lamp is ON, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.7 and 6.2.15.12.

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- 6.2.15.13 In approximately 160 seconds VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (-Z IRIG Scale Factor error in parts per million, position +00003).
- 6.2.15.14 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
-00001 ENTR
NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM lamp is on, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.7 and 6.2.15.14.
- 6.2.15.15 In approximately 160 seconds, VERB 05 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (-X IRIG Scale Factor error in parts per million, Position -00001).
- 6.2.15.16 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
-00002 ENTR
NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM lamp is ON, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.7 and 6.2.15.16.
- 6.2.15.17 In approximately 160 seconds, VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (-Y IRIG Scale Factor error in parts per million, Position -00002).
- 6.2.15.18 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
-00003 ENTR
NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM is ON, enter VERB 36 ENTR and repeat steps, 6.2.15.4 through 6.2.15.7 and 6.2.15.18.
- 6.2.15.19 In approximately 160 seconds, VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (+Z IRIG Scale Factor error in parts per million, Position -00003).
- 6.2.15.20 Repeat steps 6.2.15.8 through 6.2.15.19 twice to obtain second and third set of data.
- 6.2.15.21 Terminate this test by entering in K-148: VERB 34 ENTR
- 6.2.15.22 The average of the three readings of Scale Factor Error for each of the 6 positions shall be 0 ± 1750 PPM.

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6.2.16 IMU Performance Test

6.2.16.1 Perform Master Initialization 6.2.5.3 before proceeding.

6.2.16.2 Enter VERB 01 NOUN 10 into K148. Press the ENTER pushbutton. Enter 00003 into K148. Press the ENTER pushbutton. Record R1 = AAAAA and the time of day.

6.2.16.3 Enter VERB 21 NOUN 02 into K148. Press the ENTER pushbutton. Enter 01300 into K148. Press ENTER. Enter AAAAA into K148. Press ENTER.

6.2.16.4 Enter VERB 06 NOUN 02 into K148. Press ENTER. Enter 01300 into K148. Press ENTER. Record R1 = BBBB.

6.2.16.5 Perform the following calculations:

a. $\frac{R1 (BBBB) \times 5.12}{3600} = CCCC.C$ (hrs. in high order scaler channel 3)

b. $23.3 - CCC.C = DDDDD$ Hrs.

c. Add DDDDD to time of day recorded in step 1.

Do Not enter any of the PIPA scale factor tests within -0.2 hours of the time of day calculated in step 6.2.16.5c. This is the time at which the high order scaler, channel 3, will overflow. If a PIPA scale factor test is being performed at this time, unacceptable test results will occur.

6.2.16.6 Verify that the IMU Operate Power has been applied for at least one hour.

6.2.16.7 Test Initiation.

6.2.16.7.1 Enter the following into K148.

a. VERB 01 NOUN 01, ENTER

b. 00362, ENTER

Record R1 = XXXXY

6.2.16.7.2 Enter the following into K148

a. VERB 21 NOUN 01, ENTER

b. 00362, ENTER

c. XXXXY', ENTER where Y' is determined by Table XV and XXXX is that recorded in 6.2.16.7.1.

TABLE XV

Y (from 6.2.16.7.1)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.16.7.3 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.16.7.4 Enter 00001 into K148. Press the ENTER pushbutton.

6.2.16.7.5 On the CRT, DSKY display verify R1 (Navigation Base Azimuth) and R2 (Site Latitude) are correct.

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- 6.2.16.7.6 If values for R1 and R2 are correct, proceed to next step. If values for R1 and R2 are incorrect, enter the following sequence into K-148.

VERB 24 ENTR

+XXX.XX ENTR (Correct navigation base azimuth ± 0.50 deg)

+XX.XXX ENTR (Correct site latitude from Table XX)

Verify values in R1 and R2 are correct

TABLE XX

LOCATION	LATITUDE
NAA	+33.921
MSC	+29.556
MILA	+28.516

- 6.2.16.7.7 On K-148 enter the following sequence:

VERB 33 ENTR

VERB 06 NOUN 66 shall flash

- 6.2.16.7.8 On CRT, DSKY display, verify R1 = +00900 (Time), R2 = +00000 (Test Index No.) and R3 = +00001 (Test Position). If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR

+00900 ENTR (Test Time in Seconds)

+00000 ENTR (Test Index Number)

+00001 ENTR (Test Position Entry)

- 6.2.16.7.9 On K-148 enter the following sequence:

VERB 33 ENTR

- 6.2.16.7.10 In approximately 17 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (+NBDY) Position +00001.

- 6.2.16.7.11 On K-148 enter the following sequence:

VERB 33 ENTR

- 6.2.16.7.12 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT, record R1 and R2 (+X PIPAS) Position +00001. Row 1 is whole part, Row 2 is fractional part, Units are cm/sec.

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6.2.16.7.13 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.2.16.7.14 On CRT DSKY displays, verify $R_1 = +00900$, $R_2 = +00000$, and $R_3 = +00002$.

If values for R_1 , R_2 and R_3 are correct, proceed to next step.
If values for R_1 , R_2 and R_3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00002 ENTR (Test Position Entry)

6.2.16.7.15 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.16 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R_2 (+NBDZ) Position +00002.

6.2.16.7.17 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.18 In approximately 90 secs. VERB 06 NOUN 66 shall flash. From the CRT, record R_1 and R_2 (-X PIPAG) Position +00002.

6.2.16.7.19 On K-148 enter the following sequence:

VERB 21 NOUN 01 ENTR
00407 ENTR
77757 ENTR
VERB 21 NOUN 01 ENTR
00411 ENTR
00020 ENTR
VERB 33 ENTR

6.2.16.7.20 In approximately 67 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R_2 (-NBDX + ADLAX) Pos +00002, Record CRT CDU gimbal angle indications and time.

6.2.16.7.21 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

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6.2.16.7.22 On CRT, DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00003.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR

+00900 ENTR (Test Time in Seconds)

+00000 ENTR (Test Index Number)

+00003 ENTR (Test Position Entry)

6.2.16.7.23 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.24 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (-NBDX) Position +00003.

6.2.16.7.25 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.26 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R1 and R2 (+Z PIPAG) Position +00003.

6.2.16.7.27 On K-148 enter the following sequence:

VERB 34 ENTR

VERB 06 NOUN 66 shall flash

6.2.16.7.28 On the CRT, DSKY display verify R1 = +00900, R2 = 00000, and R3 = +00004.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR

+00900 ENTR (Test Time in Seconds)

+00000 ENTR (Test Index Number)

+00004 ENTR (Test Position Entry)

6.2.16.7.29 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.30 In approximately 17 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (+NBDY +ADSRAY) Position +00004.

6.2.16.7.31 On K-148 enter the following sequence:

VERB 33 ENTR

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- 6.2.16.7.32 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R1 and R2 (-Z PIPAG) Position +00004.
- 6.2.16.7.33 On K-148 enter the following sequence:
- VERB 21 NOUN 01 ENTR
00405 ENTR
00020 ENTR
VERB 21 NOUN 01 ENTR
00407 ENTR
77757 ENTR
VERB 33 ENTR
- 6.2.16.7.34 In approximately 67 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R2 (+NBDZ + ADIAZ) Position +00004. Record CRT CDU gimbal angle indications and time.
- 6.2.16.7.35 On K-148 enter the following sequence:
- VERB 33 ENTR
VERB 06 NOUN 66 shall flash
- 6.2.16.7.36 From the CRT DSKY display, verify R1 = +00900, R2 = +00000 and R3 = +00005.
- If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:
- VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00005 ENTR (Test Position Entry)
- 6.2.16.7.37 On K-148 enter the following sequence:
- VERB 33 ENTR
- 6.2.16.7.38 The PROG alarm and GIMBAL LOCK lamps shall light. Press Error Reset. The PROG alarm lamp shall extinguish.
- 6.2.16.7.39 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R1 and R2 (+Y PIPAG) Position +00005.
- 6.2.16.7.40 On K-148 enter the following sequence:
- VERB 34 ENTR
VERB 06 NOUN 66 shall flash

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6.2.16.7.41 On the CRT DSKY display, verify R1 = +00900, R2 = +00000 and R3 = +00006.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2, and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00006 ENTR (Test Position Entry)

6.2.16.7.42 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.43 The PROG alarm and GIMBAL LOCK lamps shall light. Press Error Reset. The PROG alarm lamp shall extinguish.

6.2.16.7.44 In approximately 90 secs VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R1 and R2. (-Y PIPAG) Position +00006.

6.2.16.7.45 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.2.16.7.46 On the CRT DSKY display, verify R1 = +00900, R2 = +00000 and R3 = +00007.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2, and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00007 ENTR (Test Position Entry)

6.2.16.7.47 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.48 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (-.707 ADSRAX-NBDX) Position +00007.

6.2.16.7.49 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

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6.2.16.7.50 On the CRT DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00008.

6.2.16.7.51 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.52 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 ☐ .707 (NBDZ+NBDY) +0.5 (ADIAZ-ADIAY) +0.5 (ADSRAY + ADSRAZ) Position +00008.

6.2.16.7.53 On K-148 enter the following:

VERB 34 ENTR

VERB 06 NOUN 66 shall flash

6.2.16.7.54 On the CRT DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00009.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR

+00900 ENTR (Test Time in Seconds)

+00000 ENTR (Test Index Number)

+00009 ENTR (Test Position Entry)

6.2.16.7.55 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.56 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (-NBDZ + .707 ADSRAZ) Position +00009.

6.2.16.7.57 On K-148 enter the following sequence:

VERB 34 ENTR

VERB 06 NOUN 66 shall flash

6.2.16.7.58 On the CRT DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00010.

If values for R1, R2, and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR

+00900 ENTR (Test Time in Seconds)

+00000 ENTR (Test Index Number)

+00010 ENTR (Test Position Entry)

6.2.16.7.59 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.60 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R2 ☐ 707 (NBDY-NBDX) + .5 (ADIAV-ADIAV) + .5 ADSRA ☐ Position +00010.

6.2.16.7.61 Terminate this test by entering in K-148 the following:

VERB 36 ENTR

6.2.16.7.62 On K-148 enter the following sequence:

VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR

6.2.16.9 Y PIPA Data Correction Calculation

6.2.16.9.1 From the uplink file tape, the compressed data tape, or the PCM tape, request a data reduction of the X and Z accelerometer ΔV counts (addresses 37 and 41, respectively) and the TIME 2 and TIME 1 registers (addresses 24 and 25, respectively) for the period during which the Y PIPA test was being performed in positions 5 and 6 of the IMU Performance Test.

6.2.16.9.2 Perform the following calculations for position 5.

$$G'_5 = \frac{G_5}{\cos \theta_{y5}}$$

Where:

G_5 = Measured acceleration term (position 5).

G'_5 = Corrected acceleration term (transfer to line 11)

$$\cos \theta_{y5} = 1 - \frac{\theta_{y5}^2}{2} \quad \text{for small angles}$$

Where:

$$\theta_{y5} = \sqrt{\theta_{x5}^2 + \theta_{z5}^2}$$

and:

$$\theta_{z5} = \frac{(\Delta V_{z5} - \Delta V_{z5} \text{ Bias}) (S.F._z)}{(\Delta T) (\text{local } g)}$$

$$\theta_{x5} = \frac{(\Delta V_{x5} - \Delta V_{x5} \text{ Bias}) (S.F._x)}{(\Delta T) (\text{local } g)}$$

and:

$$\Delta V_x \text{ Bias} = \frac{(\text{X PIPA Bias}) (\Delta T)}{S. F. x}$$

$$\Delta V_z \text{ Bias} = \frac{(\text{Z PIPA Bias}) (\Delta T)}{S. F. z}$$

S. F. and Bias terms are obtained from positions 1 through 4 of the IMU Performance Test.

6.2.16.9.3

Perform the following calculations for position 6.

$$G'_6 = \frac{G_6}{\cos \theta_{y6}}$$

Where:

G_6 = Measured acceleration term (position 6)

G'_6 = Corrected acceleration term (transfer to line 12)

$$\cos \theta_{y6} = 1 - \frac{\theta_{y6}^2}{2} \text{ for small angles}$$

$$\theta_{y6} = \sqrt{\theta_{x6}^2 + \theta_{z6}^2}$$

and:

$$\theta_{z6} = \frac{(\Delta V_{x6} - \Delta V_x \text{ Bias}) (S. F. x)}{(\Delta T) (\text{local } g)}$$

$$\theta_{x6} = \frac{(\Delta V_{z6} - \Delta V_z \text{ Bias}) (S. F. z)}{(\Delta T) (\text{local } g)}$$

and:

$$\Delta V_x \text{ Bias} = \frac{(\text{X PIPA Bias}) (\Delta T)}{S. F. x}$$

$$\Delta V_z \text{ Bias} = \frac{(\text{Z PIPA Bias}) (\Delta T)}{S. F. z}$$

S. F. and Bias terms are obtained from positions 1 through 4 of the IMU Performance Test.

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6.2.16.10 Calculations

Table XXI

Position No. As Displayed in R3	Quantity Being Measured
+00001	+NBDY +X PIPA G
+00002	+NBDZ -X PIPA G -NBDX + ADIAX
+00003	-NBDX +Z PIPA G
+00004	+NBDY + ADSRAY -Z PIPA G +NBDZ + ADIAZ
+00005	+ Y PIPA G
+00006	- Y PIPA G
+00007	-NBDX + .707 ADSRAZ
+00008	.707 (-NBDZ - NBDY) + .5 (ADIAZ - ADIAX) +.5 (ADSRAY + ADCRAZ)
+00009	-NBDZ + .707 ADSRAZ
+00010	.707 (NBDY - NBDX) + .5 (ADIAY - ADIAX) +.5 (ADSRAX)

6.2.16.10.1 Measured Values					
	<u>Line</u>	<u>Position No.</u>	<u>Step No.</u>	<u>Parameter</u>	<u>Recorded Value</u>
6.2.16.10.1.1	1	+00001	6.2.16.7.10	+NBDY	R2
6.2.16.10.1.2	2	+00001	6.2.16.7.12	+XPIPAG	R1 . R2
6.2.16.10.1.3	3	+00002	6.2.16.7.16	+NBDZ	R2
6.2.16.10.1.4	4	+00002	6.2.16.7.18	-XPIPAG	R1 . R2
6.2.16.10.1.5	5	+00002	6.2.16.7.20	-NBDX+ ADIAX	R2
6.2.16.10.1.6	6	+00003	6.2.16.7.24	-NBDX	R2
6.2.16.10.1.7	7	+00003	6.2.16.7.26	+ZPIPAG	R1 . R2
6.2.16.10.1.8	8	+00004	6.2.16.7.30	+NBDY + ADSRAY	R2
6.2.16.10.1.9	9	+00004	6.2.16.7.32	-ZPIPAG	R1 . R2
6.2.16.10.1.10	10	+00004	6.2.16.7.34	+NBDZ + ADIAZ	R2
6.2.16.10.1.11	11	+00005	6.2.16.7.39 and 6.2.16.9.2	+YPIPAG	R1 . R2
6.2.16.10.1.12	12	+00006	6.2.16.7.44 and 6.2.16.9.3	-YPIPAG	R1 . R2
6.2.16.10.1.13	13	+00007	6.2.16.7.48	-NBDX + .707ADSRAX	R2
6.2.16.10.1.14	14	+00008	6.2.16.7.52	.707 (-NBDZ- NBDY) + .5 (ADIAZ-ADIAZ) + .5 (ADSRAY + ADSRAZ)	R2
6.2.16.10.1.15	15	+00009	6.2.16.7.56	-NBDZ + .707ADSRAX	R2
6.2.16.10.1.16	16	+00010	6.2.16.7.60	.707 (NBDY - NBDX) + .5 (ADIAZ - ADIAZ) + .5 ADSRAX	R2

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6.2.16.10.2 Obtain data from last historical IRIG and PIPA test and complete Table X_{I-1}.

TABLE X_{I-1}

PARAMETER	UNITS	RECORDED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIAX	meru/g	
ADIAY	meru/g	
ADIAZ	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

6.2.16.10.3 Obtain data from the second last historical IRIG and PIPA test and complete Table X_{I-2}.

TABLE X_{I-2}

PARAMETER	UNITS	RECORDED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIAX	meru/g	

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TABLE X₁₋₂ (Continued)

PARAMETER	UNITS	RECORDED VALUE
ADIA Y	meru/g	
ADIA Z	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

- 6.2.16.10.4 Obtain data from the third last historical IRIG and PIPA test and complete Table X₁₋₃.

TABLE X₁₋₃

PARAMETER	UNITS	RECORDED VALUE
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRZ	meru/g	
ADIA X	meru/g	
ADIA Y	meru/g	
ADIA Z	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

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6.2.16.10.5 Compute the PIPA Scale Factor error in parts per million and record in Table X.

- a. PIPA S. F. Error = $\left[\frac{(2 \text{ local } g)}{+PIPAG - (-PIPAG)} - 1.000000 \right] 10^6$
- b. X PIPA S. F. Error = $\left[\frac{(2 \text{ local } g)}{\text{line 2} - \text{line 4}} - 1.000000 \right] 10^6$
- c. Y PIPA S. F. Error = $\left[\frac{(2 \text{ local } g)}{\text{line 11} - \text{line 12}} - 1.000000 \right] 10^6$
- d. Z PIPA S. F. Error = $\left[\frac{(2 \text{ local } g)}{\text{line 7} - \text{line 9}} - 1.000000 \right] 10^6$

The PIPA S. F. Error shall not exceed ± 1900 PPM.

6.2.16.10.6 Compute the PIPA Bias in cm/sec² and record in Table X₁.

- a. PIPA Bias = $\frac{+PIPAG + (-PIPAG)}{2} = \text{--- cm/sec}^2$
- b. X PIPA Bias = $\frac{\text{line 2} + \text{line 4}}{2} =$
- c. Y PIPA Bias = $\frac{\text{line 11} + \text{line 12}}{2} =$
- d. Z PIPA Bias = $\frac{\text{line 7} + \text{line 9}}{2} =$

The PIPA Bias shall not exceed ± 2.28 cm/sec².

6.2.16.10.7 Calculate NBD, ADSRA, and ADIA and record in Table X₁.

- a. NBDX = $-(\text{line 6}) =$
 NBDY = $\text{line 1} =$
 NBDZ = $\text{line 3} =$
 NBD shall not exceed ± 15 meru.
- b. ADSRAX = $\frac{(\text{line 13} - \text{line 6})}{.707} =$
 ADSRAY = $\text{line 8} - \text{line 1} =$
 ADSRAZ = $\frac{\text{line 15} + \text{line 3}}{.707} =$

ADSRA shall not exceed ± 40 meru/g.

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c. ADIAX = line 5 - line 6 =

ADIA Y = $\frac{\text{line 16} - .707 (\text{NBDY} - \text{NBDX})}{.5} - \text{ADSRAX} + \text{ADIAX}$

ADIAZ = line 10 - line 3 =

ADIA shall not exceed ± 100 meru/g.

TABLE X₁

PARAMETER	UNITS	CALCULATED VALUE
NBDX	meru	.
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIAX	meru/g	
ADIA Y	meru/g	
ADIAZ	meru/g	
X PIPA S. F. Error	PPM	
Y PIPA S. F. Error	PPM	
Z PIPA S. F. Error	PPM	
X PIPA Bias	cm/sec ²	
Y PIPA Bias	cm/sec ²	
Z PIPA Bias	cm/sec ²	

6.2.16.10.8 Perform the following calculations for each term in Table X₁, and record the results in Table D.

$$D_1 = |X_{i-1} - X_i|$$

$$D_2 = |X_{i-1} - X_i| + |X_{i-2} - X_{i-1}|$$

$$D_3 = |X_{i-3} - X_{i-2}| + |X_{i-2} - X_{i-1}| + |X_{i-1} - X_i|$$

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X_1 = data point just obtained
 X_{i-1} = last historical data point
 X_{i-2} = second last historical data point
 X_{i-3} = third last historical data point

NOTE: D_1 calculations begin with the first data point after ISS Pre-Vib; D_2 calculations begin with the second data point after ISS Pre-Vib; D_3 calculations begin with the third data point after Pre-Vib.

TABLE D

PARAMETER	UNITS	D_1	MAX	D_2	MAX	D_3	MAX
NBDX	meru		6.0		9.0		11.0
NBDY	meru		6.0		9.0		11.0
NBDZ	meru		6.0		9.0		11.0
ADSRAX	meru/g		14.0		21.0		25.0
ADSRAY	meru/g		14.0		21.0		25.0
ADSRAZ	meru/g		14.0		21.0		25.0
ADIAx	meru/g		17.0		33.0		40.0
ADIAy	meru/g		17.0		33.0		40.0
ADIAz	meru/g		17.0		33.0		40.0
X PIPA S. F. Error	PPM		400		500		600
Y PIPA S. F. Error	PPM		400		500		600
Z PIPA S. F. Error	PPM		400		500		600
X PIPA Bias	cm/sec ²		0.50		0.70		0.90
Y PIPA Bias	cm/sec ²		0.50		0.70		0.90
Z PIPA Bias	cm/sec ²		0.50		0.70		0.90

6.2.16.10.9 Failure to meet the above criteria shall result in retest according to paragraph 5.4.2.

6.2.17 SXT-NB-IMU Fine Alignment Test

6.2.17.1 Perform Master Initialization 6.2.5.3 before proceeding.

6.2.17.2 Prior to performing this test, the G&N Installation Qualification fixture shall be installed on the supporting fixture and adjusted to permit proper operation of the G&N optics. The azimuth supplied by the azimuth autotest (Optical Reference No. 1) shall be known to ± 30 minutes of arc.

NOTE: The G&N shall have had OPERATE power applied for a minimum of 1 hour. Set the G/N POWER-OPTICS switch to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $+28.0 \pm 3.0$ VDC. Verify that the OPTX 28V 800 cps 1% zero (CG1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.

6.2.17.3 Enter VERB 01 NOUN 10 into K148. Press the ENTER pushbutton. Enter 00003 into K148. Press the ENTER pushbutton. Record R1 = AAAAA.

If the recorded value is within any of the sets of limits given in Table 1 proceed with the test. If the recorded value is NOT within any of the sets of limits, wait 30 minutes and then repeat this step or enter VERR 11 NOUN 10 ENTER, 00003 ENTER and proceed when the monitored value is within the limits set in Table I.

TABLE I

MIN VALUE		MAX VALUE
00000	AAAAA	03100
04000	AAAAA	07100
10000	AAAAA	13100
14000	AAAAA	17100
20000	AAAAA	23100
24000	AAAAA	27100
30000	AAAAA	33100
34000	AAAAA	37100

6.2.17.4 Enter the following sequence into the Lower Equipment Bay (LEB) DSKY.

- a. VERB 41 NOUN 20 ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.17.5 On the G&N Indicator Control Panel set the following switches to the position indicated.

- a. OPTICS TEL TRUN to SLAVE to SXT
- b. OPTICS COUPLING to DIRECT
- c. OPTICS SPEED to LO
- d. OPTICS MODE to MAN

6.2.17.5.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC. Set OPTICS ZERO to ZERO.

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6.2.17.6 Enter the following into the DSKY.

- a. VERB 01 NOUN 01, ENTER
 - b. 00362, ENTER
- Record R1 = XXXXY

6.2.17.7 Enter the following into the DSKY

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER, where Y' is determined by table below and XXXX is that recorded in 6.2.17.6.

TABLE II

Y (From 6.2.17.6)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.17.8 Initiate the test by entering the following sequence into the LEB DSKY.

- a. VERB 57, ENTER
- b. 00003, ENTER

6.2.17.9 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data is displayed in R1 and R2 on the DSKY.

- a. R1 = +13500
- b. R2 = +xx,xxx (Site Latitude from Table I)

TABLE I

Test Site	Latitude
NAA	+33.922
MILA	+28.516
MSC	+29.556

6.2.17.10 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If the value displayed is other than +13500 in R1 and the correct Site Latitude in R2, correct the data by entering the following sequence into the DSKY.

- a. VERB 21, ENTER
- b. +13500, ENTER
- c. VERB 22, ENTER
- d. +xx,xxx, ENTER (+xx,xxx = Site Latitude from Table I)
- e. VERB 33, ENTER

6.2.17.11 Observe VERB 21 NOUN 30 flashing on the DSKY. Enter the following sequence into the DSKY.

- a. +00001, ENTER (Position Number)
- b. +00000, ENTER
- c. +00001, ENTER

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- 6.2.17.12 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Y_{NB} Azimuth)
 - R2 = ±xx.xxx (Y_{NB} Elevation)
 - R3 = 00001
- 6.2.17.13 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct Y_{NB} azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx ± 002.00 degrees, ENTER (Y_{NB} azimuth)
 - +xx.xxx ± 02.000 degrees, ENTER (Y_{NB} elevation)
 - VERB 33, ENTER
- 6.2.17.14 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Z_{NB} Azimuth)
 - R2 = ±xx.xxx (Z_{NB} Elevation)
 - R3 = 00002
- 6.2.17.15 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct Z_{NB} azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx ± 002.00 degrees, ENTER (Z_{NB} Azimuth)
 - +xx.xxx ± 02.000 degrees, ENTER (Z_{NB} elevation)
 - VERB 33, ENTER
- 6.2.17.16 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Target 1 Azimuth)
 - R2 = ±xx.xxx (Target 1 Elevation)
 - R3 = 00001
- 6.2.17.17 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct azimuth and elevation for Target 1, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx ± 000.10 degrees, ENTER (Target 1 Azimuth)
 - ±xx.xxx ± 00.010 degrees, ENTER (Target 1 Elevation)
 - VERB 33, ENTER
- 6.2.17.18 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Target 2 Azimuth)
 - R2 = ±xx.xxx (target 2 Elevation)
 - R3 = 00002

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- 6.2.17.19 If the data displayed is correct proceed to 6.2.17.20. If R1 and R2 do not contain the correct azimuth and elevation for Target 2, correct the data by entering the following sequence into the DSKY.
- a. VERB 24, ENTER
 - b. $\pm xxx.xx \pm 000.10$ degrees, ENTER (Target 2 Azimuth)
 - c. $\pm xx.xxx \pm 00.010$ degrees, ENTER (Target 2 Elevation)
- 6.2.17.20 Set the OPTICS ZERO switch to OFF. Enter VERB 33, ENTER into the DSKY.
- 6.2.17.21 When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00001, set the OPTICS MODE switch on the G&N Indicator Control Panel to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.
- 6.2.17.22 Using the Optics Hand Controller, align the SXT StLOS with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.23 When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00002 set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.
- 6.2.17.24 Using the Optics Hand Controller, align the SXT StLOS with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.
- NOTE: The following two MARKS must be performed as quickly as possible. In no case shall the time between the first and second MARK exceed two minutes.
- 6.2.17.25 After 90 seconds observe the DSKY for VERB 51 NOUN 30 flashing and R1 = 00001. Set the Optics Mode switch to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.
- 6.2.17.26 Using the Optics Hand Controller, align the SXT StLOS with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.

6. 2. 17. 27 When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00002 set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.
6. 2. 17. 28 Using the Optics Hand Controller, align the SXT StLOS with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.
6. 2. 17. 29 In approximately 7 minutes VERB 06 NOUN 66 shall flash on the DSKY and the test results shall be displayed. R1 and R2 on the DSKY shall display the misalignment of one of the horizontal PIPA's in arc seconds (R1 = whole, R2 = fractional). Record R1 and R2. (See Table II for PIPA displayed).
6. 2. 17. 30 Enter VERB 33 ENTER into the DSKY. When VERB 06 NOUN 66 flashes. R1 and R2 on the DSKY shall display the misalignment of the second horizontal PIPA in arc seconds (R1 whole, R2 fractional). (See Table II for PIPA displayed.) Record R1 and R2.
6. 2. 17. 31 Enter VERB 34 ENTER into the DSKY to terminate the test. Wait 5 seconds.
6. 2. 17. 32 Repeat steps 6. 2. 17. 3 and 6. 2. 17. 8 through 6. 2. 17. 31 substituting No.+00002 in 6. 2. 17. 11. a.
6. 2. 17. 33 Repeat Step 6. 2. 17. 3.
6. 2. 17. 34 On the G&N Indicator Control Panel, verify the following switches in the positions indicated.
- a. OPTICS TEL TRUN to SLAVE to SXT
 - b. OPTICS COUPLING to DIRECT
 - c. OPTICS SPEED to LO
 - d. OPTICS MODE to MAN
6. 2. 17. 34. 1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC. Set OPTICS ZERO to ZERO.
6. 2. 17. 35 Enter the following into the DSKY:
- a. VERB 21 NOUN 01 ENTR
 - b. 02542 ENTR
 - c. 00001 ENTR ENTR
 - d. 02543 ENTR
 - e. 00002 ENTR
6. 2. 17. 36 Repeat Steps 6. 2. 17. 8 through 6. 2. 17. 10.

- 6.2.17.37 Observe VERB 21 NOUN 30 flashing on the DSKY. Enter the following sequence into the DSKY.
- +00005, ENTER (Option Number)
 - +00000, ENTER
 - +00001, ENTER
- 6.2.17.38 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +XXX.XX (Y_{NB} Azimuth)
 - R2 = ±XX.XXX (Y_{NB} Elevation)
 - R3 = 00001
- 6.2.17.39 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct Y_{NB} azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +XXX.XX±002.00 degrees, ENTER (Y_{NB} Azimuth)
 - ±XX.XXX±02.000 degrees, ENTER (Y_{NB} Elevation)
 - VERB 33, ENTER
- 6.2.17.40 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +XXX.XX (Z_{NB} Azimuth)
 - R2 = ±XX.XXX (Z_{NB} Elevation)
 - R3 = 00002
- 6.2.17.41 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct Z_{NB} azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +XXX.XX±002.00 degrees, ENTER (Z_{NB} Azimuth)
 - ±XX.XXX±02.000 degrees, ENTER (Z_{NB} Elevation)
 - VERB 33, ENTER
- 6.2.17.42 When VERB 06 NOUN 61 flashes on DSKY, enter the following:
- VERB 24 ENTR
 - +13500 ENTR
 - +00000 ENTR
- 6.2.17.43 Observe R3 = 00001. Enter VERB 33 ENTR.

6. 2. 17. 44 When VERB 06 NOUN 61 flashes on DSKY, enter the following:
- a. VERB 24 ENTR
 - b. +22500 ENTR
 - c. +00000 ENTR
6. 2. 17. 45 Observe R3 = 00002. Enter VERB 33 ENTR.
6. 2. 17. 46 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- a. R1 = +XXX.XX (Target 1 Azimuth)
 - b. R2 = ±XX.XXX (Target 1 Elevation)
 - c. R3 = 00001
6. 2. 17. 47 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct azimuth and elevation for Target 1, correct the data by entering the following sequence into the DSKY.
- a. VERB 24, ENTER
 - b. +XXX.XX±000.10 degrees, ENTER (Target 1 Azimuth)
 - c. ±XX.XXX±00.010 degrees, ENTER (Target 1 Elevation)
 - d. VERB 33, ENTER
6. 2. 17. 48 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- a. R1 = +XXX.XX (Target 2 Azimuth)
 - b. R2 = ±XX.XXX (Target 2 Elevation)
 - c. R3 = 00002
6. 2. 17. 49 If the data displayed is correct proceed to 6. 2. 17. 50. If R1 and R2 do not contain the correct azimuth and elevation for Target 2, correct the data by entering the following sequence into the DSKY.
- a. VERB 24, ENTER
 - b. ±XXX.XX±000.10 degrees, ENTER (Target 2 Azimuth)
 - c. ±XX.XXX±00.010 degrees, ENTER (Target 2 Elevation)
6. 2. 17. 50 Set the OPTICS ZERO switch to OFF. Enter VERB 33, ENTER into the DSKY.
6. 2. 17. 51 When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00001, set the OPTICS MODE switch on the G&N Indicator Control Panel to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.

- 6.2.17.52 Using the Optics Hand Controller, align the SXT StLOS with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.53 When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00002 set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.
- 6.2.17.54 Using the Optics Hand Controller, align the SXT StLOS with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.

NOTE: The following two MARKS must be performed as quickly as possible. In no case shall the time between the first and second MARK exceed two minutes.

- 6.2.17.55 After 90 seconds observe the DSKY for VERB 51 NOUN 30 flashing and R1 = 00001. Set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.
- 6.2.17.56 Using the Optics Hand Controller, align the SXT StLOS with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.57 When the DSKY displays VERB 51 NOUN 30 flashing and R1 = 00002 set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.
- 6.2.17.58 Using the Optics Hand Controller, align the SXT StLOS with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.59 In approximately 7 minutes VERB 06 NOUN 66 shall flash on the DSKY and the test results shall be displayed. R1 and R2 on the DSKY shall display the misalignment of one of the horizontal PIPA's in arc-seconds (R1 = whole, R2 = fractional). Record R1 and R2. (See Table II for PIPA displayed).

6. 2. 17. 60 Enter VERB 33 ENTER into the DSKY. When VERB 06 NOUN 66 flashes, R1 and R2 on the DSKY shall display the misalignment of the second horizontal PIPA in arc-seconds (R1 = whole, R2 = fractional). (See Table II for PIPA displayed). Record R1 and R2.
6. 2. 17. 61 Enter VERB 34 ENTER into the DSKY to terminate the test. Wait 5 seconds.
6. 2. 17. 62 Repeat Steps 6. 2. 17. 33 through 6. 2. 17. 61, substituting numbers as follows:
- 00000 in Step 6. 2. 17. 35. c
00001 in Step 6. 2. 17. 35. e
- +00000 in Step 6. 2. 17. 44. b
+89999 in Step 6. 2. 17. 44. c
6. 2. 17. 63 Enter the following into the DSKY:
- a. VERB 36 ENTER
 - b. VERB 41 NOUN 20 ENTER
 - c. +00000 ENTER
 - d. +00000 ENTER
 - e. +00000 ENTER

TABLE II. Display Conditions at Test Completion

Position	SM Orientation			Horizontal Misalignment Component	
	X _{SM}	Y _{SM}	Z _{SM}	6. 2. 17. 29 & .59	6. 2. 17. 30 & .60
1	UP	SW	SE	Y _{SM}	Z _{SM}
2	SE	SW	DN	X _{SM}	Y _{SM}
4	DN	SE	SW	Y _{SM}	Z _{SM}
5	SW	SE	UP	X _{SM}	Y _{SM}

6. 2. 17. 64 Set the G/N POWER-OPTICS switch on the LEM Lighting Control Panel to OFF.
6. 2. 17. 65 Calculations
6. 2. 17. 65. 1
- a. Y_{SM} misalignment = () $\frac{R1 \cdot R2}{R1 + R2}$
 - b. Z_{SM} misalignment = () $\frac{R1 \cdot R2}{R1 + R2}$
 - c. X_{SM} misalignment = () $\frac{R1 \cdot R2}{R1 + R2}$
 - d. Y_{SM} misalignment = () $\frac{R1 \cdot R2}{R1 + R2}$
 - e. Y_{SM} misalignment = () $\frac{R1 \cdot P2}{R1 + P2}$
 - f. Z_{SM} misalignment = () $\frac{R1 \cdot R2}{R1 + R2}$
 - g. X_{SM} misalignment = () $\frac{R1 \cdot R2}{R1 + R2}$
 - h. Y_{SM} misalignment = () $\frac{R1 \cdot R2}{R1 + R2}$

6.2.17.65.2 Enter the latest values from 6.2.16 IMU Performance Test

- a. X PIPA bias = _____ cm/sec²
- b. Y PIPA bias = _____ cm/sec²
- c. Z PIPA bias = _____ cm/sec²
- d. $\theta_X = 210$ (X PIPA bias) = _____ arc-sec.
- e. $\theta_Y = 210$ (Y PIPA bias) = _____ arc-sec.
- f. $\theta_Z = 210$ (Z PIPA bias) = _____ arc-sec.

6.2.17.65.3

- a. Z_{SM} misalignment (bias corrected) =
6.2.17.65.1.b - θ_Z = _____ arc-sec.
- b. X_{SM} misalignment (bias corrected) =
6.2.17.65.1.c - θ_X = _____ arc-sec.
- c. Y_{SM} misalignment (bias corrected) =
6.2.17.65.1.e - θ_Y = _____ arc-sec.
- d. Y_{SM} misalignment (bias corrected) =
6.2.17.65.1.h - θ_Y = _____ arc-sec.

The SM misalignments in each orientation, excluding PIPA bias, shall not exceed ± 150 arc-seconds.

6.2.18

Gyrocompassing Test

NOTE: Perform Master Initialization 6.2.5.3 before proceeding.

6.2.18.1

Set the G/N POWER-OPTICS Switch on the L&B Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is $+28.0 \pm 3.0$ VDC. Verify that OPTX 28V 800 cps 1 $\frac{1}{2}$ zero (CG 1211) and OPTX 28V 800 cps 5 $\frac{1}{2}$ - 90°h (CG 1212) are not flashing on the CRT.

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6.2.18.2 Enter the following into the DSKY.

- a. VERB 01 NOUN 01, ENTER
- b. 00362, ENTER
- Record R1 = XXXXY

6.2.18.3 Enter the following into the DSKY.

- a. VERB 21 NOUN 01, ENTER
- b. 00362, ENTER
- c. XXXXY', ENTER where Y' is determined by Table II and XXXX is that recorded in 6.2.18.2.

Table II

Y (From 6.2.18.2)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.18.4 Enter the following sequence into the K-Start, pressing ENTER pushbutton after each entry.

- a. VERB 57, ENTER
- b. 00006, ENTER

6.2.18.5 System shall advance to Gyrocompass System Test and display 01 on the CRT program display.

6.2.18.6 On the CRT observe VERB 06, NOUN 61 flashing with some launch azimuth displayed in R1 = +xxx.xx.

6.2.18.6.1 If the azimuth displayed is correct proceed to 6.2.18.5; if not, perform the following sequence:

- a. VERB 21, Press ENTER pushbutton
- b. +xxx.xx, press ENTER pushbutton (Correct Launch Azimuth)

6.2.18.7 After verifying that the correct launch azimuth is displayed in R1 on the CRT, Enter VERB 33 on the K-START and push the ENTER pushbutton.

6.2.18.8 Observe VERB 06 NOUN 61 flashing on the CRT with the following displayed in R1 and R2.

- a. R1 = +xxx.xx, Nav. Base Azimuth (Z_{NB})
- b. R2 = +xx.xxx, Site Latitude

6.2.18.8.1 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence:

To correct R1:

- a. VERB 21, ENTER
- b. +xxx.xxx000.50 degrees, ENTER (Z_{NB} Azimuth)

To correct R2:

- a. Verb 22, ENTER
- b. +xx.xxx, ENTER (Correct Site Latitude from Table I)

- 6.2.18.9 Gyrocompassing Stability
- 6.2.18.9.1 Enter VERB 33, ENTER into the DSKY. On the DSKY observe the PROGRAM display change to 05 after approximately 90 seconds. Approximately 5 minutes later observe the PROGRAM display change to 02. When PROG display changes to 02 record time as T_0 .
- 6.2.18.9.2 120 minutes after T_0 record the Outer, Inner and Middle CDU Gimbal angles from the CRT.
- 6.2.18.9.3 Repeat above step every 5 minutes for the next 60 minutes.
- 6.2.18.9.4 The peak-to-peak spread of the outer gimbal angle shall not exceed 0.12 degrees.
- 6.2.18.9.5 The peak-to-peak spread of the Inner and Middle gimbal angles shall not exceed 0.06 degrees.
- 6.2.18.10 Gyrocompassing Accuracy
- 6.2.18.10.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Between 175 minutes and 180 minutes from T_0 set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.10.2 Enter the following into the DSKY.
- a. VERB 21 NOUN 03 ENTER
 - b. 02663 ENTER
 - c. +XXX.XX±000.01 ENTER (Target No. 1 Az)
 - d. Press ENTER Pushbutton
 - e. 02664 ENTER
 - f. +XXX.XX±000.01 ENTER (Target No. 2 Az)
 - g. Press ENTER Pushbutton
 - h. 02665 ENTER
 - i. +00.000 ENTER (Target No. 1 EL)
 - j. Press ENTER Pushbutton
 - k. 02666 ENTER
 - l. +00.000 ENTER (Target No. 2 EL)
- On the G&N Indicator Control Panel set the OPTICS ZERO switch to OFF, set the OPTICS MODE switch to MAN and the OPTICS SPEED switch to HI. Drive the StLOS to the approximate position of Target No. 1. Set the OPTICS SPEED Switch to LO.
- NOTE: Read the following 10 steps before proceeding. These are time critical steps and must be performed as rapidly as possible.
- 6.2.18.11 After 180 minutes from T_0 enter VERB 52 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT change to 03.

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- 6.2.18.12 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 1 azimuth and elevation.
- a. R1 = +xxx.xx (Target 1 azimuth)
 - b. R2 = +00.000 (Target 1 elevation)
- 6.2.18.13 Verify the data appearing in R1 and R2 and if correct, proceed. If not correct, perform the following sequence.
- a. VERB 24, ENTER
 - b. +xxx.xx±000.01, ENTER (Target 1 azimuth)
 - c. +00.000, ENTER (Target 1 elevation)
- 6.2.18.14 After the correct readings for R1 and R2 are verified, enter VERB 33 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.15 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 2 azimuth and elevation.
- a. R1 = +xxx.xx (Target 2 azimuth)
 - b. R2 = +00.000 (Target 2 elevation)
- 6.2.18.16 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence.
- a. VERB 24, ENTER
 - b. +xxx.xx±000.01, ENTER (Target 2 azimuth)
 - c. +00.000, ENTER (Target 2 elevation)

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- 6.2.18.17 After the correct readings for R1 and R2 are verified enter VERB 33 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.18 Using the Optics Hand Controller, align the SXT StLOS to target 1 and press the MARK pushbutton. If satisfied that the MARK was good, proceed. If not satisfied with MARK, press the MARK REJECT pushbutton and repeat the step.
- 6.2.18.19 Set the OPTICS SPEED switch to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target No. 2.
- 6.2.18.20 Set the OPTICS SPEED switch to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 2 and press the MARK pushbutton. If satisfied that the MARK was good, press the ENTER pushbutton. If not satisfied, press the MARK REJECT pushbutton and repeat this step.
- 6.2.18.21 On the CRT observe the following data displayed:
- a. VERB 06 NOUN 60
 - b. R1 = $\pm xx.xxx$ (X gyro elevation error, degrees)
 - c. R2 = $\pm xx.xxx$ (Y gyro elevation error, degrees)
 - d. R3 = $\pm xx.xxx$ (Z gyro azimuth error, degrees)
- Record R1, R2 and R3.
- 6.2.18.22 Enter VERB 34 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT and DSKY's indicate 02. Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.23 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.24 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start three times. Press the ENTER pushbutton after each entry. Set the G/N POWER OPTICS Switch on the LEB Lighting Control Panel to OFF.

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6.2.18.25 Data Sheet

TIME	CDUX	CDUY	CDUZ
To			
To +15			
To +30			
To +45			
To +60			
To +75			
To +90			
To +105			
To +120			
To +125			
To +130			
To +135			
To +140			
To +145			
To +150			
To +155			
To +160			
To +165			
To +170			
To +175			
To +180			

NOTES: 1. Record CDU angles at times indicated. (T₀ is the time at the start of test - Prog 02)

Line	Step	Parameter	Recorded Value
1	6.2.18.21	X Gyro Elevation Error	±R1 degrees
2		Y Gyro Elevation Error	±R2 degrees
3		Z Gyro Azimuth Error	±R3 degrees

6.2.18.26 Calculation Sheet

6.2.18.26.1 Record the most recent values of the following coefficients from 6.2.16, IMU Performance Test.

- a. NBDX = () _____
- b. NBDY = () _____
- c. NBDZ = () _____
- d. ADIAZ = () _____
- e. ADSRAY = () _____

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6.2.18.26.2 Perform the following calculations. (Cos λ functions are provided in Table I.)

- a. $D_{(vert)} = NBDZ + ADIAZ$
 $D_{(vert)} = ()$ meru
- b. $D_{(east)} = \sin(\text{Launch Az}) NBDX + \cos(\text{Launch Az}) NBDY + ADSRAY$
- c. $\phi_{(vert)} = \frac{D_{(vert)} \times \frac{12.8}{\cos \lambda} + D_{(east)} \times \frac{206}{\cos \lambda}}{3600}$
 $\phi_{(vert)} = ()$ degrees

Table I

Location	Latitude λ	Cos λ
NAA	33.921	0.82985
MILA	28.516	0.87868
MSC	29.556	0.86993

6.2.18.26.3 Perform the following calculations using the recorded data from 6.2.18.25 and 6.2.18.26.2.

- a. Z Gyro azimuth error 3 hrs (corrected) = line 3 - $\phi_{(vert)}$
Z Gyro azimuth error 3 hrs (corrected) = _____ corrected
Z Gyro azimuth error (corrected) shall be 0.00 ± 0.573 degrees.
- b. X Gyro elevation error (3 hr) = line 1
X Gyro elevation error (3 hr) = _____ deg
X Gyro elevation error (comp) = X elevation error (R1) + (57.3 A_{BY}) / g
- c. Y Gyro elevation error (3 hr) = line 2
Y Gyro elevation error (3 hr) = _____ deg
Y Gyro elevation error (comp) = Y elevation error (R2) - (57.3 A_{BX}) / g

The X and Y compensated elevation errors shall be 0.00 ± 0.045 degree.

6.2.19 CMC Voltage Margin Test

6.2.19.1 Verify that the G&N IMU HTR MNA and MNB breakers are engaged, computer MNA and MNB breakers are engaged, IMU MNA and MNB breakers are not engaged, and the G&N Power-IMU switch on the LEB Lighting Control Panel is in the OFF position. On K-148, enter VERB 36 ENTR.

6.2.19.2 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to ON.

CAUTION: During the performance of this test the +4 VDC CMC Power Supply shall not be operated at less than +2.5 VDC or greater than 5.2 VDC (CG 1030). The +14 VDC CMC Power Supply shall not be operated at less than +8.5 VDC or greater than +17.0 VDC (CG 1020). Rotate the LEB LTS NUMERICS SEL to approximately center position. Decrease to absolute minimum

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6.2.19.2 discernible lighting.
(cont)

NOTE: The flashing indication of the CMC Power Supplies on CRT may be disregarded for this test. The charts in Table I may be used to determine approximate values for the "XX.X" values of C-156 voltage dial settings corresponding to various power supply voltages.

6.2.19.2.1 Into R-153, insert 1100. Verify and execute.

6.2.19.3 Units R-154, insert 0001. Verify and execute.

6.2.19.4 Insert in C-156, -010001244 and execute. Verify on CRT that GV0116 is between 0.0 and -2.0 vdc.

6.2.19.5 Insert in C-156 -015001234 and execute. Verify on CRT that GV0106 is between -0.5 and -2.5 vdc.

6.2.19.6 Units R-154, insert 0111. Verify and execute.

6.2.19.7 Observe CG 1020, +14 VDC Power Supply, and CG 1030, +4 VDC Power Supply on CRT. Repeat 6.2.19.3 through 6.2.19.6 adjusting each C Start entry until CG 1020 is 12.1, +0.1, -0.0 vdc and CG 1030 is 3.40, +0.03, -0.00 vdc.

6.2.19.8 Initiate CMC Self Check by inserting the following in K-148.

- a. ERROR RESET
- b. VERB 21, NOUN 27, ENTER
- c. 77777, ENTER

Wait 200 seconds.

6.2.19.9 Insure that the DSKY RESTART lamp does not light, and that

- a. VERB 05 NOUN 31
 - b. R1 = 01102
- does not appear on DSKY.

6.2.19.9.1 Into R-154, insert 0101. Verify and execute.

6.2.19.10 Set INHIBIT VOLTAGE FAIL switch to OFF on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. If RESTART lamp does not light, repeat 6.2.19.3. Verify CMC Warning master alarms are lighted.

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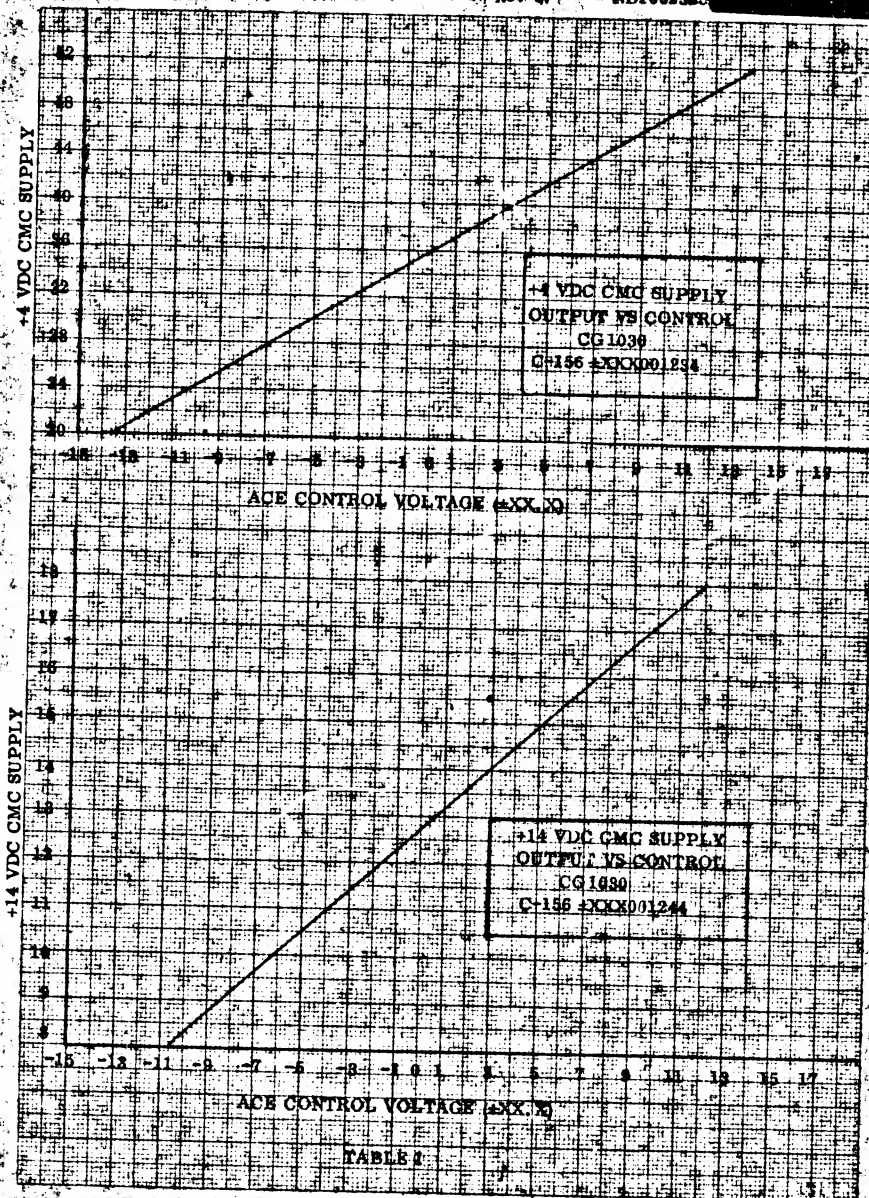
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- 6.2.19.11 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- ERROR RESET
 - VERB 21, NOUN 27, ENTER
 - 77777, ENTER
- 6.2.19.12 Units R-154, insert 0001. Verify and execute.
- 6.2.19.13 Insert in C-156 +084001244 and execute. Verify on CRT that GV0116 is between +7.4 and 9.4 vdc.
- 6.2.19.14 Units R-154, insert 0111. Verify and execute.
- 6.2.19.15 Observe CG 1020, +14 VDC Power Supply on CRT. Repeat 6.2.19.12 through 6.2.19.14 adjusting the C Start entry until CG 1020 is 16.4, +0.1, -0.0 vdc.
- 6.2.19.16 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- VERB 05, NOUN 31
 - R1 = 01102
- does not appear on DSKY
- 6.2.19.16.1 Into R-154, insert 0011. Verify and execute.
- 6.2.19.17 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted.
- 6.2.19.18 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- ERROR RESET
 - VERB 21, NOUN 27, ENTER
 - 77777, ENTER
- 6.2.19.19 Units R-154, insert 0001. Verify and execute.
- 6.2.19.20 Insert in C-156, +082001234 and execute. Verify on CRT that GV0106 is between +7.2 and +9.2 vdc.
- 6.2.19.21 Units R-154, insert 0111. Verify and execute.
- 6.2.19.22 Observe CG 1030, +4 VDC Power Supply on CRT. Repeat 6.2.19.19 through 6.2.19.21 adjusting the C Start entry until CG 1030 is 4.60, +0.08 -0.00 vdc.
- 6.2.19.23 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- VERB 05, NOUN 31
 - R1=01102
- does not appear on DSKY.
- 6.2.19.23.1 Into R-154, insert 0101. Verify and execute.

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- 6.2.19.24 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted.
- 6.2.19.25 Set INHIBIT VOLTAGE FAIL switch to ON, on PSAAM. Insert into K-148:
- a. ERROR RESET
 - b. VERB 21, NOUN 27, ENTER
 - c. 77777, ENTER.
- 6.2.19.26 Units R-154, insert 0001. Verify and execute.
- 6.2.19.27 Insert in C-156, -010001244 and execute. Verify on CRT that GV0116 is between 0.0 and -2.0 vdc.
- 6.2.19.28 Units R-154, insert 0111. Verify and execute.
- 6.2.19.29 Observe CG 1020, +14 VDC Power Supply on CRT. Repeat 6.2.19.26 through 6.2.19.28 adjusting the C Start entry until CG 1020 is 12.1, +0.1, -0.0 vdc.
- 6.2.19.30 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:
- a. VERB 05, NOUN 31
 - b. R1 = 01102
- does not appear on DSKY.
- 6.2.19.30.1 Into R-154, insert 0011. Verify and execute.
- 6.2.19.31 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted.
- 6.2.19.32 Units R-154, insert 0000. Verify and execute.
- 6.2.19.33 Terminate CMC Self-Check by inserting into K-148:
- a. ERROR RESET
 - b. VERB 21, NOUN 27, ENTER
 - c. 00000, ENTER
- 6.2.19.34 Ensure that CG 1020, +14 VDC Power Supply indication is +14.0, ± 0.4 , and that CG 1030, +4 VDC Power Supply indication is +4.00 ± 0.20 VDC on CRT.



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6.2.20 * Spacecraft Control and Displays Test

6.2.20.1 Perform Master Initialization before proceeding.

6.2.20.2 FDAI Attitude Error

6.2.20.2.1 Insert in K146

- a. V 57 ENTER
- b. 00013 ENTER

6.2.20.2.2 Observe on CRT

- a. V 06 NO1 Flashing
- b. PROG 07
- c. NO ATT ON
- d. R1, R2, and R3 Approx. 00000

6.2.20.2.3 Insert in K146

- a. VERB 33, ENTER

6.2.20.2.4 Observe on CRT

- a. V 06 NO1 Flashing
- b. R1 +00385
- c. R2 -00385
- d. R3 +00385
- e. NO ATT OFF

6.2.20.2.5 Record CRT indications

- a. CG 2279 ROLL ATT ERROR - CDU DAC OUT +5.06±0.66 VRMS
- b. CG 2219 PITCH ATT ERROR - CDU DAC OUT -5.06±0.66 VRMS
- c. CG 2249 YAW ATT ERROR - CDU DAC OUT +5.06±0.66 VRMS

6.2.20.2.6 Insert in K146

- a. VERB 33, ENTER

6.2.20.2.7 Observe on CRT

- a. V 06 NO1 Flashing
- b. R1 +00384
- c. R2 -00384
- d. R3 +00384

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6.2.20.2.8 Record CRT indications

- | | | |
|------------|-------------------------------|-----------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | +5.06±0.66 VRMS |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | -5.06±0.66 VRMS |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | +5.06±0.66 VRMS |

6.2.20.2.9 Insert in K148

- a. VERB 33, ENTER

6.2.20.2.10 Observe on CRT

- | | | |
|---------|-----|----------|
| a. V 06 | N01 | Flashing |
| b. R1 | | +00160 |
| c. R2 | | -00160 |
| d. R3 | | +00160 |

6.2.20.2.11 Record CRT indications

- | | | |
|------------|-------------------------------|-----------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | +2.11±0.27 VRMS |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | -2.11±0.27 VRMS |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | +2.11±0.27 VRMS |

6.2.20.2.12 Insert in K148

- a. VERB 33, ENTER

6.2.20.2.13 Observe on CRT

- | | | |
|---------|-----|----------|
| a. V 06 | N01 | Flashing |
| b. R1 | | +00135 |
| c. R2 | | -00135 |
| d. R3 | | +00135 |

6.2.20.2.14 Record CRT indications

- | | | |
|------------|-------------------------------|-----------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | +1.78±0.23 VRMS |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | -1.78±0.23 VRMS |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | +1.78±0.23 VRMS |

6.2.20.2.15 Insert in K148

- a. VERB 33, ENTER

6.2.20.2.16 Observe on CRT

- | | | |
|---------|-----|----------|
| a. V 06 | N01 | Flashing |
| b. R1 | | +00090 |
| c. R2 | | -00090 |
| d. R3 | | +00090 |

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6.2.20.2.17 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	+1.19±0.15 VRMS
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	-1.19±0.15 VRMS
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	+1.19±0.15 VRMS

6.2.20.2.18 Insert in K148

a. VERB 33, ENTER

6.2.20.2.19 Observe on CRT

a. V 06	NO1	Flashing
b. R1		+00000
c. R2		+00000
d. R3		-00000

6.2.20.2.20 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	0.00±0.06 VRMS
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	0.00±0.06 VRMS
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-1.19±0.15 VRMS

6.2.20.2.21 Insert in K148

a. VERB 33, ENTER

6.2.20.2.22 Observe on CRT

a. V 06	NO1	Flashing
b. R1		-00090
c. R2		+00090
d. R3		-00135

6.2.20.2.23 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-1.19±0.15 VRMS
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+1.19±0.15 VRMS
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	-1.78±0.23 VRMS

6.2.20.2.24 Insert in K148

a. VERB 33, ENTER

6.2.20.2.25 Observe on CRT

a. V 06	NO1	Flashing
b. R1		-00135
c. R2		+00135
d. R3		-00160

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6.2.20.2.26 Record CRT indications

- | | | |
|------------|-------------------------------|-----------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | -1.78±0.23 VRMS |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +1.78±0.23 VRMS |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | -2.11±0.27 VRMS |

6.2.20.2.27 Insert in K148

- a. VERB 33, ENTER

6.2.20.2.28 Observe on CRT

- | | | |
|---------|-----|----------|
| a. V 06 | NOL | Flashing |
| b. R1 | | -00100 |
| c. R2 | | -00160 |
| d. R3 | | -00304 |

6.2.20.2.29 Record CRT indications

- | | | |
|------------|-------------------------------|-----------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | -2.11±0.27 VRMS |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +2.11±0.27 VRMS |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | -5.06±0.66 VRMS |

6.2.20.2.30 Insert in K148

- a. VERB 33, ENTER

6.2.20.2.31 Observe on CRT

- | | | |
|---------|-----|----------|
| a. V 06 | NOL | Flashing |
| b. R1 | | -00304 |
| c. R2 | | +00304 |
| d. R3 | | -00385 |

6.2.20.2.32 Record CRT indications

- | | | |
|------------|-------------------------------|-----------------|
| a. CG 2279 | ROLL ATT ERROR - CDU DAC OUT | -5.06±0.66 VRMS |
| b. CG 2219 | PITCH ATT ERROR - CDU DAC OUT | +5.06±0.66 VRMS |
| c. CG 2249 | YAW ATT ERROR - CDU DAC OUT | -5.06±0.66 VRMS |

6.2.20.2.33 Insert in K148

- a. VERB 33, ENTER

6.2.20.2.34 Observe on CRT

- | | | |
|---------|-----|----------|
| a. V 06 | NOL | Flashing |
| b. R1 | | -00305 |
| c. R2 | | +00385 |
| d. R3 | | +00000 |

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6.2.20.2.35 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-5.06±0.66 VRMS
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+5.06±0.66 VRMS
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	0.00±0.06 VRMS

6.2.20.2.36 Insert in K148

a. V 21	NO1	ENTER
b. 02545		ENTER
c. 02837		ENTER
d. V 33		ENTER

6.2.20.2.37 Observe on CRT

a. V 06	NO2	Flashing
b. NO ATT		ON
c. R1		+00000 approximately
d. R2		+00000 approximately
e. R3		+00000 approximately

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6.2.20.3 TVC Test

6.2.20.3.1 The G/N Autopilot Control and SPS Ready discretes shall be applied to the G/N interface.

6.2.20.3.2 Set the OPTICS MODE selector on the Indicator Control panel to MAN. Set the OPTICS ZERO switch to OFF.

6.2.20.3.3 Insert in K148

a. VERB 33, ENTER

6.2.20.3.4 Observe on CRT

a. V 01	N 10	Flashing
b. R1		X7373
c. R3		00030

6.2.20.3.5 Insert in K148

a. V 33 ENTER

6.2.20.3.6 Observe on CRT

a. V 01	NOUN 10	Flashing
b. R1		37777
c. R3		00031

6.2.20.3.7 Insert in K148

a. V 33 ENTER

6.2.20.3.8 Observe on CRT

a. V 06	N 02	Flashing
b. R1		+00385
c. R2		-00385
d. R3		+00003

6.2.20.3.9 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+10.12±1.00 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	-10.12±1.00 VRMS

6.2.20.3.10 Insert in K148

a. VERB 33, ENTER

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6.2.20.3.11 Observe on CRT

a. V 06	N 02	Flashing
b. R1		+00384
c. R2		-00384
d. R3		+00003
e. NO ATT		OFF

6.2.20.3.12 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+10.12±1.00 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	-10.12±1.00 VRMS

6.2.20.3.13 Insert in K148

a. VERB 33, ENTER

6.2.20.3.14 Observe on CRT

a. V 06	N 02	Flashing
b. R1		+00160
c. R2		-00160
d. R3		+00003

6.2.20.3.15 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+4.22±0.42 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	-4.22±0.42 VRMS

6.2.20.3.16 Insert in K148

a. VERB 33, ENTER

6.2.20.3.17 Observe on CRT

a. V 06	N 02	Flashing
b. R1		+00135
c. R2		-00135
d. R3		+00003

6.2.20.3.18 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+3.56±0.36 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	-3.56±0.36 VRMS

6.2.20.3.19 Insert in K148

a. VERB 33, ENTER

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6.2.20.3.20 Observe on CRT

a. V 06	N 02	Flashing
b. R1		+00090
c. R2		-00090
d. R3		+00003

6.2.20.3.21 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+2.38±0.24 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	-2.38±0.24 VRMS

6.2.20.3.22 Set the OPTICS SPEED Switch on the Indicator Control Panel to HL

6.2.20.3.23 Insert in K148

a. VERB 33, ENTER

6.2.20.3.24 Observe on CRT

a. V 06	N 02	Flashing
b. R1		+00000
c. R2		+00000
d. R3		+00003

6.2.20.3.25 While holding the Optics Hand Controller up and left (45°) no longer than 10 seconds, record CRT indications.

a. CG 3722	TRUNNION CDU DAC OUTPUT	0.00±0.12 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	0.00±0.12 VRMS

6.2.20.3.26 Insert in K148

a. VERB 33, ENTER

6.2.20.3.27 Observe on CRT

a. V 06	N 02	Flashing
b. R1		-00090
c. R2		+00090
d. R3		+00003

6.2.20.3.28 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-2.38±0.24 VRMS
b. CG 3721	SHAFT CDU DAC OUTPUT	+2.38±0.24 VRMS

- 6.2.20.3.29 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the Indicator Control Panel to ZERO for 30 seconds, then return to OFF.
- 6.2.20.3.30 Insert in K148
- a. VERB 33, ENTER
- 6.2.20.3.31 Observe on CRT
- a. V 06 N 02 Flashing
b. R1 -00135
c. R2 +00135
d. R3 +00003
- 6.2.20.3.32 Record CRT indications
- a. CG 3722 TRUNNION CDU DAC OUTPUT -3.56 ± 0.36 VRMS
b. CG 3721 SHAFT CDU DAC OUTPUT $+3.56 \pm 0.36$ VRMS
- 6.2.20.3.33 Insert in K148
- a. VERB 33, ENTER
- 6.2.20.3.34 Observe on CRT
- a. V 06 N 02 Flashing
b. R1 -00160
c. R2 +00160
d. R3 +00003
- 6.2.20.3.35 Record CRT indications
- a. CG 3722 TRUNNION CDU DAC OUTPUT -4.22 ± 0.42 VRMS
b. CG 3721 SHAFT CDU DAC OUTPUT $+4.22 \pm 0.42$ VRMS
- 6.2.20.3.36 Insert in K148
- a. VERB 33, ENTER
- 6.2.20.3.37 Observe on CRT
- a. V 06 N 02 Flashing
b. R1 -00384
c. R2 +00384
d. R3 +00003

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6.2.20.3.38 Record CRT indications

- | | | |
|------------|-------------------------|------------------|
| a. CG 3722 | TRUNNION CDU DAC OUTPUT | -10.12±1.00 VRMS |
| b. CG 3721 | SHAFT CDU DAC OUTPUT | +10.12±1.00 VRMS |

6.2.20.3.39 Insert in K148

- a. VERB 33, ENTER

6.2.20.3.40 Observe on CRT

- | | | |
|---------|------|----------|
| a. V 06 | N 02 | Flashing |
| b. R1 | | -00385 |
| c. R2 | | +00385 |
| d. R3 | | +00003 |

6.2.20.3.41 Record CRT indications

- | | | |
|------------|-------------------------|------------------|
| a. CG 3722 | TRUNNION CDU DAC OUTPUT | -10.12±1.00 VRMS |
| b. CG 3721 | SHAFT CDU DAC OUTPUT | +10.12±1.00 VRSM |

6.2.20.3.42 Insert in K148

- | | | |
|-----------|------|-------|
| a. V 34 | | ENTER |
| b. V 40 | N 20 | ENTER |
| c. V 41 | N 20 | ENTER |
| d. +00000 | | ENTER |
| e. +00000 | | ENTER |
| f. +00000 | | ENTER |

APPENDIX I

<u>Signal</u>	<u>Link</u>	<u>Nomenclature</u>	<u>G&N Test Requirement</u>	<u>PSAAM and/or SCA Uncertainty % of Full Scale</u>
CG 1020	1	+14 VDC CMC SUPPLY	+14.0 ± 0.4 VDC	0%
CG 1030	1	+4 VDC CMC SUPPLY	+4.00 ± 0.2 VDC	0%
CG 1040	2	+120 VDC PIPA SUPPLY	+120 ± 6.0 VDC	1%
CG 1051	1	+20 VDC PIPA SUPPLY	+20.0 ± 1.2 VDC	0%
CG 1052	1	-20 VDC PIPA SUPPLY	-20 ± 2 VDC	0%
CG 1070	1	+4 VDC CDU SUPPLY	+4.0 ± 0.2 VDC	0%
CG 1100	1	-28 VDC SUPPLY	-27.5 ± 6.0 VDC	0%
CG 1110	2	2.5 VDC TM BIAS	+2.50 ± 0.06 VDC	0%
CG 1201	2	IMU 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	1%
CG 1202	1	IMU 28V .8KC 5% -90° RMS	28.0 ± 1.4 VRMS	0.33%
CG 1203	1	IMU 28V .8KC 0° RMS	28.0 ± 2.1 VRMS	0.33%
CG 1207	1	PH DIFF IMU 5% 0°, -90°	-90 ± 10°	2.3%
CG 1211	1	OPTX 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	0.33%
CG 1212	1	OPTX 28V .8KC 5% -90° RMS	28.00 ± 1.48 VRMS	0.33%
CG 1220	1	PH DIFF OPTX 1% IMU 1%	0° ± 10°	2.3%
CG 1331	2	3.2 KC 28V SUPPLY	28.6 ± 0.56 VRMS	1%
CG 1336	1	PH DIFF 3.2 KC 28V/CMC SYNC	0° ± 10°	2.3%
CG 1500	1	+28 VDC IMU OPERATE BUS	28.8 ± 3 VDC	0%
CG 1510	1	+28 VDC IMU STANDBY BUS	28.8 ± 3 VDC	0%
CG 1520	1	+28 VDC CMC OPERATE BUS	28.8 ± 3 VDC	0%
CG 1530	1	+28 VDC OPTX OPERATE BUS	28.8 ± 3 VDC	0%
CG 2001	2	X PIPA SG O/P	5 VRMS max	3%
CG 2021	2	Y PIPA SG O/P	5 VRMS max	0.23%
CG 2041	2	Z PIPA SG O/P	5 VRMS max	3%
CG 2108	1	IG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3.6%
CG 2112	2	IG 1X RESOLVER O/P SIN	18.38 ± 1.84 VRMS at 45°	2.5%
CG 2113	2	IG 1X RESOLVER O/P COS	18.38 ± 1.84 VRMS at 45°	2.5%
CG 2117	2	IG SERVO ERROR IN PHASE	0.0 ± 60 mv RMS at null	1.4%
CG 2120	1	IG TORQUE MOTOR CURRENT	0.125 amp max during Fine Alignment Torquing	0%
CG 2138	1	MG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3.6%
CG 2142	2	MG 1X RESOLVER O/P SIN	18.38 ± 1.84 VRMS at 45°	2.5%
CG 2143	2	MG 1X RESOLVER O/P COS	18.38 ± 1.84 VRMS at 45°	2.5%
CG 2147	2	MG SERVO ERROR IN PHASE	0.0 ± 60 mv RMS at null	1.4%
CG 2150	1	MG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	0%
CG 2168	1	OG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3.6%
CG 2172	2	OG 1X RESOLVER O/P SIN	18.38 ± 1.84 VRMS at 45°	2.5%
CG 2173	2	OG 1X RESOLVER O/P COS	18.38 ± 1.84 VRMS at 45°	2.5%
CG 2177	2	OG SERVO ERROR IN PHASE	0.0 ± 60 mv RMS at null	1.4%
CG 2180	1	OG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	0%
CG 1042	1	+120 VDC PIPA SUP NOISE RMS	1.5 VRMS max	0%
CG 1053	1	+20 VDC PIPA SUP NOISE RMS	1.0 VRMS max	0%
CG 1071	1	+4 VDC CDU SUP NOISE RMS	0.10 VRMS max	0%
CG 1501	1	+28V IMU OPERATE BUS NOISE RMS	1.0 VRMS max	0%
CG 1511	1	+28V IMU STANDBY BUS NOISE RMS	1.0 VRMS max	0%
CG 1521	1	+28V CMC OPERATE BUS NOISE RMS	2.0 VRMS max	0%
CG 1531	1	+28V OPTX OPERATE BUS NOISE RMS	2.0 VRMS max	0%

Signal	Link	Nomenclature	G&N Test Requirement	PSAAM and/or SCA
				Uncertainty % of Full Scale
CG 2219	1	PITCH ATT ERROR - CDU DAC O/P	5.06 ± 0.5 VRMS at 17°	0.67%
CG 2220	1	IG CDU FINE ERROR	0.0 ± 0.07 VRMS at null	0.29%
CG 2221	1	IG CDU COARSE ERROR	0.0 ± 0.68 VRMS at null	0.29%
CG 2249	1	YAW ATT ERROR-CDU DAC O/P	5.06 ± 0.5 VRMS at 17°	0.67%
CG 2250	1	MG CDU FINE ERROR	0.0 ± 0.07 VRMS at null	0.29%
CG 2251	1	MG CDU COARSE ERROR	0.0 ± 0.68 VRMS at null	0.29%
CG 2279	1	ROLL ATT ERROR-CDU DAC O/P	5.06 ± 0.5 VRMS at 17°	0.67%
CG 2280	1	OG CDU FINE ERROR	0.0 ± 0.07 VRMS 2 null	0.29%
CG 2281	1	OG CDU COARSE ERROR	0.0 ± 0.68 VRMS	0.29%
CG 2300	1	PIPA TEMPERATURE	$130.5 \pm 1.5^\circ\text{F}$ Operate Mode	2%
CG 3011	2	TRUNNION CDU FINE ERROR	0.0 ± 0.07 VRMS at null	0.29%
CG 3021	1	SHAFT CDU FINE ERROR	0.0 ± 0.07 VRMS at null	0.29%
CG 3117	1	SXT SHAFT SERVO ERROR IN PH	2 VRMS max	1.1%
CG 3118	1	SXT TRUNNION SERVO ERROR IN PHASE	2 VRMS max	1.1%
CG 3140	1	SXT SHAFT TACH O/P	3.3 ± 1.3 VRMS at Hi Rate	1.1%
CG 3145	1	SXT SHAFT MTR CONTROL WINDING	$+0.50$ to $+4.00$ VRMS Med Rate	1.1%
CG 3150	1	SXT TRUNNION TACH O/P	3.3 ± 1.3 VRMS at Hi Rate	1.1%
CG 3155	1	SXT TRUNNION MTR CONTROL WINDING	$+0.25$ to $+2.00$ VRMS Med Rate	1.1%
CG 3160	1	SCT SHAFT TACH O/P	3.3 ± 1.3 VRMS at Hi Rate	1.1%
CG 3170	1	SCT TRUNNION TACH O/P	0.85 ± 0.35 VRMS at Hi Rate	1.1%
CG 3721	1	SHAFT CDU DAC O/P	10.12 ± 1.00 VRMS at 17°	1%
CG 3722	2	TRUNNION CDU DAC O/P	10.12 ± 1.00 VRMS at 17°	1%
CG 4300	2	CMC TEMP	$87.5 \pm 42.5^\circ\text{F}$	0.23%
CG 6020	1	PIPA CAL MODULE TEMP	$72.5 \pm 27.5^\circ\text{F}$	0.23%
CG 6021	1	IMU 800 cps 5% TEMP (PSA)	$90 \pm 30^\circ\text{F}$	0%
CG 2301	1	IRIG TEMPERATURE	$135 \pm 2.5^\circ\text{F}$ in Operate	2%
CG 1021	1	+14V CMC SUPPLY NOISE RMS	0.2 VRMS max	0%
CG 1031	1	+4 CMC SUPPLY NOISE RMS	0.2 VRMS max	0%

PSAAM OUTPUT is the source of Link 1 signals.
SCA OUTPUT is the source of Link 2 signals.

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ADDENDUM I

SCOPE: The following changes are required to make ND1002325 applicable as G&N System technical support documentation for CSM 101.

Addition 1. Add paragraph 6.1.1.7 as follows:

6.1.1.7 Data from the on-board tape recorder shall be made available and the following signals verified:

- a. IG TORQUE MOTOR CURRENT (CG 2120) shall be less than 0.125 amp max.
- b. OG TORQUE MOTOR CURRENT (CG 2180) shall be less than 0.125 amp max.
- c. MG TORQUE MOTOR CURRENT (CG 2150) shall be less than 0.125 amp max.

Addition 2. Paragraph 6.2.1.5.6, change the last sentence to read as follows:

On the Event Recorder verify that the IMU HTR Current switch discrete (CG 2302 Link 2) is on and that the IMU Blower Current discrete (CG 2303 Link 2) is OFF over the last 2 hour period (occasionally discretes may cycle).

Addition 3. Add paragraph 6.2.4.6.1 as follows:

6.2.4.6.1 On the analog recorder verify that (CG 1211 Link 2, OPTICS 28V 800 cps 1% 0 deg) RMS voltage is 28.0 ± 0.06 VAC.

Addition 4. Add Paragraph 6.2.20.2.5.1 and 6.2.20.2.32.1 as follows:

6.2.20.2.5.1 Verify on the analog recorder the following signals:

- a. CG 2279 Link 2 ROLL ATT ERROR - CDU DAC OUT $+5.06 \pm 0.66$ VRMS
- b. CM 2219 Link 2 PITCH ATT ERROR - CDU DAC OUT -5.06 ± 0.66 VRMS
- c. CG 2249 Link 2 YAW ATT ERROR - CDU DAC OUT $+5.06 \pm 0.66$ VRMS

6.2.20.2.32.1 Verify on the analog recorder the following signals:

- a. CG 2279 Link 2 ROLL ATT ERROR - CDU DAC OUT -5.06 ± 0.66 VRMS
- b. CG 2219 Link 2 PITCH ATT ERROR - CDU DAC OUT $+5.06 \pm 0.66$ VRMS
- c. CG 2249 Link 2 YAW ATT ERROR - CDU DAC OUT -5.06 ± 0.66 VRMS

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Addition 5. Paragraph 6.1.2.1., add new Paragraph 6.1.2.1.5 as follows:

6.1.2.1.5 Data from the on-board tape recorder shall be made available and the following signals verified.

- a. VIB NB ROLL (CG 6001)
- b. VIB NB PITCH (CG 6002)
- c. VIB NB YAW (CG 6003)

Addition 6. Replace Paragraph 6.2.3.1.13 with the following:

6.2.3.1.13 30 minutes after switching from Standby mode to the Operate mode record the IRIG temperature. The recorded IRIG temperature shall be within 0.5 deg F. of the Operate stabilized IRIG temperature determined below.

Add the following sentence to Paragraph 6.2.3.1.14:

Record the Operate mode stabilized IRIG temperature. The Operate mode stabilized IRIG temperature shall be $135 \pm 2.5^\circ \text{F}$.

Paragraph 6.2.5.2.16, add the following to Table VI:

14 CG 2301 IRIG TEMPERATURE

Addition 7. Paragraph 6.1.1.6, add item "f" as follows:

- f. The TRACKER switch on G&N Indicator Control Panel shall be set to OFF.

Addition 8. Replace Paragraph 6.2.3.1.2 with the following:

6.2.3.1.2 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Switch and selectors on the G&N Indicator Control Panel shall be set as follows.

- a. OPTICS MODE to ZERO
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to MED
- d. TELESCOPE TRUNNION to SLAVE to SXT
- e. RETICLE BRIGHTNESS to minimum brightness position

Addition 9. Replace Paragraph 6.2.5.1.2 with the following:

6.2.5.1.2 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the

following switches on the G&N Indicator Control Panel to the positions designated.

- a. OPTICS MODE to ZERO
- b. CONTROLLER MODE to DIRECT
- c. CONTROLLER SPEED to LO
- d. TELESCOPE TRUNNION to SLAVE to SXT
- e. RETICLE BRIGHTNESS to minimum brightness position

Addition 10. Replace Paragraph 6.2.5.2.1 with the following:

6.2.5.2.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set or verify the following G&N Indicator Control Panel switches to the position indicated.

- a. CONDITION LAMPS to ON
- b. OPTICS MODE to ZERO
- c. CONTROLLER COUPLING to DIRECT
- d. CONTROLLER SPEED to LO
- e. TELESCOPE TRUNNION to SLAVE to SXT
- f. RETICLE BRIGHTNESS to minimum brightness position

Addition 11. Replace Paragraph 6.2.5.3.6 with the following:

6.2.5.3.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Insure that the following switches are set to the positions indicated:

- a. CONTROLLER COUPLING to DIRECT
- b. OPTICS MODE to ZERO
- c. TELESCOPE TRUNNION to SLAVE to SXT
- d. TRACKER to OFF
- e. CONTROLLER SPEED to LO
- f. CONDITION LAMPS to ON
- g. UP TELEMETRY to ACCEPT

Addition 12. Replace Paragraph 6.2.9.23 with the following:

6.2.9.23 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to CMC.

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Addition 13. Replace Sections 6.2.10 through 6.2.13 with the following:

6.2.10 Zero Optics Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2 Turn On Procedure before proceeding.

INITIALIZATION

6.2.10.1 Set the G/N POWER - OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.10.2 Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.

- VERB 41, NOUN 20, ENTER
- +00000, ENTER
- +00000, ENTER
- +00000, ENTER

6.2.10.3 Insure that the following switches on the G&N Indicator Control Panel are set as follows:

- TELESCOPE TRUNNION to SLAVE to SXT
- CONTROLLER COUPLING to DIRECT
- CONTROLLER SPEED to HI

OPTICS ZERO MODE TEST

6.2.10.4 Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K-148. Press the ENTER pushbutton.

6.2.10.5 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following on R1 and R2 of the DSKY.

- R1 = +0.00° +0.02°, -0.03° (Shaft Angle)
- R2 = +0.000° +0.006°, -0.007° (Trunnion LOS Angle)

- 6.2.10.5.1. Enter the following
- VERB 01 NOUN 10, ENTER
00033, ENTER
Verify R1 = XXX6X
- 6.2.10.5.2 Set the OPTICS MODE switch to CMO. Enter the following:
- ENTER
00033, ENTER
Verify R1 = XXX5X
- 6.2.10.5.3 Set the OPTICS MODE switch to MAN. Press the KEY REL pushbutton on the DSKY.
- OPTICS BACKUP MODE TEST
- 6.2.10.6 Insert the Inflight Tool (V36601405) into the Trunnion Tool Input and engage drive mechanism (button out). Verify that the trunnion turns by viewing the movement through the SCT eyepiece while turning the tool until the TPAC reads +5 deg. Remove the tool from the trunnion tool input.
- 6.2.10.7 Insert the Inflight Tool (V36601405) into the Shaft Tool Input and engage the drive mechanism (button out): Verify that the Shaft turns by viewing the movement through the SCT eyepiece while turning the tool so that the shaft moves through an angle from 0° to +3 to -3 to 0 as indicated on the shaft TPAC. Disengage the shaft drive mechanism (button in) and remove the tool.

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6.2.10.8 Insert the Inflight Tool (V36601405) into the Trunnion Tool input. Verify that the Trunnion Turns by viewing the movement through the SCT eyepiece while turning the tool so that the trunnion moves from +5° to -5° and back to zero as indicated on the Trunnion TPAC. Disengage the trunnion drive mechanism (button in) and remove the tool.

6.2.11 Optics Coordinate Transformation Control Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure before proceeding.

INITIALIZATION

6.2.11.1 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.11.2 Enter the following into the K-Start. Press the ENTER pushbutton after each entry:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.11.3 Verify and/or set the following switches on the G&N Indicator control panel to the position indicated.

- a. TELESCOPE TRUNNION to SLAVE to SXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to HI

6.2.11.4 Set up the analog recorders to monitor the following measurements.

- a. CG 3170 SCT Trunnion Tachometer Output

6.2.11.5 Enter the following into the K-Start to monitor the OPTICS CDU's.

VERB 16 NOUN 55, press ENTER

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- 6.2.11.6** Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the G&N Panel to ZERO. Wait 15 seconds. Return the OPTICS MODE switch to MAN.
- RESOLVED MODE PHASING AND IMAGE RATE TEST**
- 6.2.11.7** Using the Optics Control Stick, drive the Optics until R1 = +225.00 and R2 = +10.000 on the CRT and the DSKY's.
- 6.2.11.8** Set the CONTROLLER COUPLING switch on the G&N Panel to RSLV and CONTROLLER SPEED switch to MED.
- 6.2.11.9** Position the movable optics target such that it is centered on the SCT reticle pattern, then start the analog recorders at a chart speed of 10 mm/second.
- 6.2.11.10** Quickly displace the Optics Control Stick 45 ± 10 degrees in the upper right hand quadrant while sighting on the optics target through the SCT eyepiece. The target shall appear to move in the upper right field of view of the SCT at 45 ± 10 deg. When target leaves the SCT upper right field of view press MARK pushbutton and immediately record the shaft angle as displayed on R1 of the DSKY. The recorded shaft angle shall be $+225 \pm 10.00$ degrees.
- 6.2.11.11** Stop the analog recorder and measure the elapsed time between the initial and the final signal null conditions for the Trunnion measurement. The elapsed time shall be +19 to +32 seconds.
- CSM AMPLIFIER SHAFT AND TRUNNION DRIVE TEST**
- 6.2.11.12** Set the CONTROLLER COUPLING switch to DIRECT. Again using the Optics Control Stick, drive the optics until R1 = +225.00 and R2 = +10.000. Set the CONTROLLER COUPLING switch to RSLV.
- 6.2.11.13** While sighting on the optical target through the SCT eyepiece, displace the Optics Control Stick fully to the right. Verify that the target image appears to move in a straight line horizontally to the right and release the Optics Control Stick when the target image reaches the edge of the SCT field of view.
- 6.2.11.14** Enter VERB 34 in the DSKY. Press the ENTER pushbutton.

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- 6.2.11.15 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the CONTROLLER COUPLING switch on the G&N Panel to DIRECT. Set the OPTICS MODE switch to ZERO. After 15 seconds, return the switch to MAN.

NOTE: If optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.12 Optics Functional Test

Proceed with this test if 6.2.3 Operate Power On Test, or 6.2.5.2 Turn-on Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding.

NOTE: This test requires the use of the G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT StLOS before proceeding. Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.

- 6.2.12.1 Set/verify the G/N POWER OPTICS switch on the LEB Lighting Control Panel to OPTICS. Set TRACKER switch to OFF. Verify the following:

- +28 VDC OPTX OPERATE BUS (CG 1530) is 28.8±3 VDC. Record the indication on the CRT.
- CG 1211 OPTX 28V 800 cps 1% 0 ph not flashing on CRT.
- CG 1212 OPTX 800 cps 5% -90 ph not flashing on CRT.

- 6.2.12.2 Enter the following sequence into the K-Start.

- VERB 41, NOUN 20, ENTER
- +00000, ENTER
- +00000, ENTER
- +00000, ENTER

- 6.2.12.3 Insure that the optics control switches on the G&N Indicator Control Panel are set as follows:

- OPTICS MODE to MAN
- CONTROLLER SPEED to LO
- CONTROLLER COUPLING to DIRECT
- TELESCOPE TRUNNION to SLAVE to SXT

- 6.2.12.4 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees to zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN.
- 6.2.12.5 Resolution Checks
- 6.2.12.5.1 Sight through the SXT eyepiece. Using the Optic Control Stick, adjust the SXT to obtain the best reflected field of view of the 5-inch autocollimator reticle engraving at the center of the field of view.
- 6.2.12.5.2 Note that the autocollimator reticle contains a series of lines of different thickness and width. Each set of lines is marked with a number (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines. The SXT resolution shall be at least 10 arc-seconds at the center of the field of view.
- 6.2.12.5.3 Repeat 6.2.12.5.1 and 6.2.12.5.2 using the SCT and the SCT resolution chart. The SCT shall have a resolution of at least 3 arc-minutes at the center of the field of view.
- 6.2.12.6 Slave Telescope Mode Checks
- 6.2.12.6.1 Enter VERB 16 NOUN 55 into the K-Start, press the ENTER pushbutton.
- 6.2.12.6.2 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the Control Indicator Panel to ZERO. Wait 15 seconds.
- 6.2.12.6.3 Record the SCT Shaft and Trunnion angles as indicated by the TPAC and the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between the TPAC shaft angle and the Shaft CDU angle shall be ± 0.11 deg or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be ± 0.22 deg or less.

- 6.2.12.6.4 Place the OPTICS MODE switch to MAN. Using the Optics Control Stick drive the SXT Shaft and Trunnion CDU's until $R1 = 035.00 \pm 0.10$ deg and $R2 = +35.000 \pm 0.100$ deg, setting the CONTROLLER SPEED switch to LO as the angles are approached. Press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles as indicated by the TPAC. Record $R1$ and $R2$. The difference between the TPAC Shaft angle and Shaft CDU angle shall be ± 0.11 deg or less. The difference between the TPAC Trunnion angle and Trunnion CDU angle shall be ± 0.22 deg or less.
- 6.2.12.6.5 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO.
- 6.2.12.6.6 Set the TELESCOPE TRUNNION switch to SLAVE to SXT position.
- 6.2.12.6.7 Remove the plug from the base of the SXT eyepiece and install the Adapter Assembly and Portable Light Assembly. Turn on the light.
- NOTE: If needed to reduce external light, place a photographer hood over the optics head and retroreflecting prism.
- 6.2.12.6.8 Sight through the SCT eyepiece and provide direction to personnel outside spacecraft for positioning the Retroreflecting Prism, Model No. A23-200, to span between the SXT LLOS and SCT LOS such that the illumination from the back-light filament is clearly visible at the center of the field of view. Prism must be held in this alignment position until completion of step 6.2.12.6.11.
- 6.2.12.6.9 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Note the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement, expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. For instance, the outer ends of the SXT reticle lines are 6% from center. Displacement shall be less than 50% (bar must be closer to center than to edge of field of view).
- 6.2.12.6.10 Set the TELESCOPE TRUNNION switch to 0° position.
- 6.2.12.6.11 Again direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in Step 6.2.12.6.9. Place the OPTICS MODE switch to MAN and observe the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement, expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. Displacement shall be less than 50%.
- 6.2.12.6.12 Remove the Retroreflecting Prism.

- 6.2.12.6.13 Replace the Portable Light in the adapter on the SXT eyepiece.
- 6.2.12.6.14 While sighting into the SCT eyepiece, set the TELESCOPE TRUNNION switch to 25° and observe that the resolution pattern mounted outside the spacecraft appears to move downward from the center of the field of view to the zero reticle marking that is 25° below the center of the field of view.
- 6.2.12.6.15 Record the TPAC Trunnion Angle. It shall be 25.00 ± 0.22 deg.
- 6.2.12.6.16 Set the TELESCOPE TRUNNION switch to SLAVE to SXT.
- 6.2.12.7 SXT Parallelism Tests
- 6.2.12.7.1 Using the Optics Control Stick drive the SXT StLOS Trunnion to $+15.000^\circ \pm 2^\circ$ as indicated in R2 of the DSKY. Maintain a Shaft CDU angle of $000.00^\circ \pm 0.10$ degrees as indicated by R1 of the DSKY.
- 6.2.12.7.2 Sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to superimpose the SXT LLOS horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.
- 6.2.12.7.3 Repeat 6.2.12.7.2 twice. Calculate and record the average of the three autocollimator readings.
- 6.2.12.7.4 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO.
- 6.2.12.7.5 Again sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to bring the SXT StLOS horizontal reticle and autocollimator horizontal filar images to coincide. Record the autocollimator reading.
- 6.2.12.7.6 Repeat 6.2.12.7.5 twice. Calculate and record the average of the three autocollimator readings. The average value obtained here shall not differ from that obtained in 6.2.12.7.3 by more than 10 arc-seconds.
- 6.2.12.7.7 Set the OPTICS MODE switch to MAN. Using the Optics Control Stick drive the SXT Trunnion angle to 85.00 ± 5 degrees as indicated on R2 of the DSKY. Set the CONTROLLER SPEED switch to LO and drive the SXT Trunnion to $+90.000$ degrees ± 0.100 degree as indicated on R2 of the DSKY. Insure that the SXT Shaft angle remains at 000.00 ± 0.10 degree as indicated by R1 on the DSKY.
- 6.2.12.7.8 Sight through the SXT. Two reticle patterns shall be visible. Use the Optics Control Stick to adjust the SXT Trunnion angle until the two horizontal reticle lines are coincident. Record the Trunnion CDU angle displayed in R2. The Trunnion CDU angle shall be 90.000 ± 0.10 degrees.
- 6.2.12.7.9 Remove the Portable Light Assembly and Adapter Assembly from the base of the SXT eyepiece. Replace the SXT eyepiece plug.

NOTE: If optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

- 6.2.12.8 Shaft and Trunnion Positional Accuracy Checks
- 6.2.12.8.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds, return the selector to Manual.
- 6.2.12.8.2 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.3 Sight through the SXT. Using the control stick align the SXT SLOS with optical Target No. 1 on the G&N Installation Fixture Model A23-097. Set the CONTROLLER SPEED switch to LO as the target is approached. When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.
- 6.2.12.8.4 Sight through the SXT. Using the control stick align the SXT SLOS with Optical Target No. 2 on A23-097. Set the CONTROLLER SPEED switch to LO as the target is approached.
- 6.2.12.8.5 When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.
- 6.2.12.8.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds set the switch to CMC.
- 6.2.12.8.7 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.8 Enter the value recorded from R1 in 6.2.12.8.3 into the K-Start. Press the enter pushbutton.
- 6.2.12.8.9 Enter the value recorded from R2 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.10 Sight through the SXT. The SLOS should be centered on Optical Target No. 1 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.3 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.11 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.12 Enter the value recorded from R1 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.

- 6.2.12.8.13 Enter the value recorded from R2 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.14 Sight through the SXT. The SLOS should be centered on Optical Target No. 2 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.5 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.15 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MANUAL.
- 6.2.12.8.16 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start 8 times. Press the ENTER pushbutton after each entry.
- 6.2.13 Optics Slew Rate Test
- NOTE: Perform Master Initialization 6.2.5.3 before proceeding.
- 6.2.13.1 Set/verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CB 1530) is $+28.0 \pm 3.0$ VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT. Set TRACKER switch to OFF.
- 6.2.13.2 Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.
- a. VERB 41 NOUN 20, ENTER
 - b. +00000, ENTER
 - c. +00000, ENTER
 - d. +00000, ENTER
- 6.2.13.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the positions indicated.
- a. TELESCOPE TRUNNION to SLAVE to SXT
 - b. CONTROLLER COUPLING to DIRECT
 - c. CONTROLLER SPEED to HI
- 6.2.13.4 Monitor MARK Command by entering VERB 06 NOUN 56 into K-148. Press the ENTER pushbutton.

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TRUNNION SLEW RATE - HI SPEED

6.2.13.5

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS MODE switch on the G&N Indicator Panel to MAN.

6.2.13.5.1

During the Trunnion Slew Rate Test HI Speed, monitor and verify the following signals on the CRT.

- a. SXT TRUNNION TACH O/P (CG 3150 LINK 2) shall be 3.3 ± 1.3 VRMS
 - b. SCT TRUNNION TACH O/P (CG 3170 LINK 2) shall be -0.85 ± 0.35 VRMS
- NOTE: Read and understand step 6.2.13.6 before proceeding. Do not hold Control Stick at upper limit more than 10 seconds, or exceed a trunnion angle of 85 degrees.

6.2.13.6

While slewing the optics, record the SXT TRUN SERVO error (CG 3118); it shall be between -0.25 and 2.0 VRMS. Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R2 = $\pm XX.XXX$ (Trunnion LOS angle in deg)
- b. R3 = $+XXX.XX$ (Time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.7

Perform the following calculations:

NOTE: In performing calculation b. below, and in similar calculations throughout this test procedure, the following shall be noted and taken into account. It is possible that the second R3 reading may be smaller than the first reading. If so, add an overflow time value of 163.84 sec to the second reading and then subtract the first reading, in order to obtain Δ time as the difference of the two R3 readings.

- a. Difference between R2 displays = _____ (Δ trunnion angle)
- b. Difference between R3 displays = _____ (Δ time)
- c. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}} = \text{--- deg/sec}$

The Trunnion Slew Rate shall be 10 ± 2 deg/sec.

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SHAFT SLEW RATE - HI SPEED

6.2.13.8 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion claved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Monitor MARK Command by entering VERB.06 NOUN 56 in K-148. Press the ENTER pushbutton.

6.2.13.8.1 During the Shaft Slew Rate Test - HI Speed, monitor and verify the following signals on the CRT.

- a. SXT SHAFT TACH O/P (CG 3140 Link 2) shall be 3.3 ± 1.3 VRMS
 - b. SCT SHAFT TACH O/P (CG 3160 Link 2) shall be 3.3 ± 1.3 VRMS
- NOTE: Read and understand step 6.2.13.9 before proceeding. Do not hold Control Stick at right limit for more than 10 seconds, or exceed a shaft angle of 250 degrees.

6.2.13.9 While slewing the optics, record the SXT SHAFT SERVO error (CG 3117); it shall be between -0.25 and -2.0 VRMS.

6.2.13.9 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R1 = $\pm XXX.XX$ (shaft angles in deg)
- b. R3 = $+XXX.XX$ (time in seconds)

After the display has changed, again record the values of R1 and R3.

6.2.13.10 Perform the following calculations:

- a. Difference between R1 displays = $\text{---} \cdot \text{---}$ (Δ shaft angle)
- b. Difference between R3 displays = $\text{---} \cdot \text{---}$ (Δ time)
- c. $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{---} \cdot \text{---}$ deg/sec

The Shaft Slew Rate shall be 19.5 ± 3.9 deg/sec.

TRUNNION SLEW RATE - MED SPEED

6.2.13.11

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to MED. Monitor MARK command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.12 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

6.2.13.12.

Record the SXT TRUN MTR control winding (CG 3155) and SXT TRUN TACH (CG 3150) signals on the CRT while slewing the optics. CG 3155 shall be +0.25 to +2.00 VRMS, and CG 3150 shall be +0.33 ± 0.13 VRMS. Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R2 = ±XX.XXX (trunnion LOS angle in deg)
- b. R3 = +XXX.XX (time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.13

Perform the following calculations:

- a. Difference between R2 displays = Δ trunnion angle
- b. Difference between R3 displays = Δ time
- c. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}} = \text{deg/sec}$

The Trunnion Slew Rate shall be 1.0 ± 0.2 deg/sec.

SHAFT SLEW RATE - MED SPEED

6.2.13.14

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS Mode switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.15 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.15

Record the SXT SHAFT MTR control winding (CG 3145), and SXT SHAFT TACH (CG 3140) signals on the CRT while slewing the optics. CG 3145 shall be $+0.50$ to $+4.00$ VRMS, and CG 3140 shall be 0.33 ± 0.13 VRMS. Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R1 = $\pm XXX.XX$ (shaft angle in deg)
- b. R3 = $+XXX.XX$ (time in seconds)

After display has changed, again record the values of R1 and R3.

6.2.13.16

Perform the following calculations:

- a. Difference between R1 displays = $--- \cdot ---$ (Δ shaft angle)
- b. Difference between R3 displays = $--- \cdot ---$ (Δ time)
- c. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = --- \text{ deg/sec}$

The Shaft Slew Rate shall be 2.0 ± 0.4 deg/sec.

TRUNNION SLEW RATE - LO SPEED

6.2.13.17

Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within ± 5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the Controller SPEED switch to LO. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

6.2.13.17.1

During the Trunnion Slew Rate Test-Lo Speed, monitor and verify the following signal on the CRT.

- a. TRUNNION CDU FINE ERROR (CG 3011 Link 2) ± 0.07 VRMS MAX

NOTE: Read and understand 6.2.13.18 before proceeding. Do not hold control stick at upper limit for more than 30 seconds.

6.2.13.18

Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R2 = $\pm XX.XXX$ (trunnion LOS angle in deg)
- b. R3 = $+XXX.XX$ (time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.19 Perform the following calculations:

- a. Difference between R2 displays = XX.XXX (Δ trunnion angle)
- b. Difference between R3 displays = XXX.XX (Δ time)
- c. $\frac{\Delta \text{trunnion angle}}{\Delta \text{time}} = \text{--- deg/sec}$

The Trunnion Slew Rate shall be 0.10 ± 0.02 deg/sec

SHAFT SLEW RATE - LO SPEED

6.2.13.20 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Monitor MARK Command by entering Verb 06 NOUN 56 in K-148. Press the ENTER pushbutton.

6.2.13.20.1 During the Shaft Slew Rate Test - Lo Speed, monitor and verify the following signal on the CRT.

- a. SHAFT CDU FINE ERROR (CG 3021 Line 2) ± 0.07 VRMS MAX

NOTE: Read and understand 6.2.13.21 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.21 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

- a. R1 = \pm XXX.XX (shaft angles in deg)
- b. R3 = \pm XXX.XX (time in seconds)

After the display has changed, again record the values of R1 and R3.

6.2.13.22 Perform the following calculations:

- a. Difference between R1 displays = --- (Δ shaft angle)
- b. Difference between R3 displays = --- (Δ time)
- c. $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{--- deg/sec}$

The Shaft Slew Rate shall be 0.20 ± 0.04 deg/sec

OPTICS HAND CONTROLLER DRIFT RATE CHECK-LO SPEED

6.2.13.23 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

6.2.13.24 Press the MARK pushbutton and record the display in R1, R2, and R3. Approximately 60 seconds after the first MARK, again press the first MARK pushbutton and record the new data displayed in R1, R2 and R3. The data displayed is in the following form:

- R1 = ±XXX.XX (shaft angle in deg)
- R2 = ±XX.XXX (trunnion LOS angle in deg)
- R3 = +XXX.XX (time in seconds)

6.2.13.25 Perform the following calculations:

- Difference between R1 displays = _____ (Δ shaft angle)
- Difference between R2 displays = _____ (Δ trunnion angle)
- Difference between R3 displays = _____ (Δ time)
- $\frac{\Delta \text{shaft angle}}{\Delta \text{time}} = \text{_____ deg/sec (Shaft Drift Rate)}$

Shall be less than 0.0333 deg/sec.

- $\frac{\Delta \text{trunnion angle}}{\Delta \text{time}} = \text{_____ deg/sec (Trunnion Drift Rate)}$

Shall be less than 0.0167 deg/sec.

6.2.13.26 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

Addition 14. Replace Paragraph 6.2.17.5 and 6.2.17.20 with the following:

6.2.17.5 On the G&N Indicator Control Panel, set the following switches to the position indicated.

- TELESCOPE TRUNNION to SLAVE to SXT
- CONTROLLER COUPLING to DIRECT
- CONTROLLER SPEED to LO
- OPTICS MODE to MAN

6.2.17.20 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN. Enter VERB 33, ENTER into the DSKY.

Addition 15. Replace Paragraphs 6.2.18.10.1, 6.2.18.10.2, 6.2.18.19, 6.2.18.20, and 6.2.18.22 with the following:

6.2.18.10.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Between 235 minutes and 240 minutes from T_0 set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.

6.2.18.10.2 Enter the following into the DSKY:

- a. VERB 21 NOUN 03 ENTER
- b. 02663 ENTER
- c. +XXX.XX±000.01 ENTER (Target No. 1 Az)
- d. Press ENTER pushbutton
- e. 02664 ENTER
- f. +XXX.XX±000.01 ENTER (Target No. 2 Az)
- g. Press ENTER pushbutton
- h. 02665 ENTER
- i. +00.000 ENTER (Target No. 1 EL)
- j. Press ENTER pushbutton
- k. 02666 ENTER
- l. +00.000 ENTER (Target No. 2 EL)

On the G&N Indicator Control Panel, set the OPTICS MODE switch to MAN and the CONTROLLER SPEED switch to HI. Drive the St. LOS to the approximate position of Target No. 1. Set the CONTROLLER SPEED switch to LO.

NOTE: Read the following 10 steps before proceeding. These are time critical steps and must be performed as rapidly as possible.

6.2.18.19 Set the CONTROLLER SPEED switch to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target 2.

6.2.18.20 Set the CONTROLLER SPEED switch to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 2 and press the MARK pushbutton. If satisfied that the MARK was good, press the ENTER pushbutton. If not satisfied, press the MARK REJECT pushbutton and repeat this step.

- 6.2.18.22 Enter VERB 34 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT and DSKY's indicate 02. Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the G&N Indicator Control Panel to Zero.
- Addition 16. Replace Paragraph 6.2.20.3.2, 6.2.20.3.22, and 6.2.20.3.29 with the following:
- 6.2.20.3.2 Set the OPTICS MODE selector on the Indicator Control Panel to MAN.
- 6.2.20.3.22 Set the OPTICS CONTROLLER SPEED switch on the Indicator Control Panel to HI.
- 6.2.20.3.29 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the Indicator Control Panel to ZERO for 30 seconds, then return to MAN.

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ADDENDUM II

SCOPE: The following changes are required to make ND1002325 applicable as G&N System technical support documentation for systems containing SUNDIAL C test ropes. Refer to Drawing 2014999 to define further which test ropes and jumper modules shall be installed.

Change 1: Paragraphs 6.2.9.1.4, 6.2.9.2a, 6.2.9.3a, 6.2.9.5a, 6.2.9.6a, 6.2.9.7a, 6.2.9.8, 6.2.9.10a, 6.2.9.11a, 6.2.9.13a, 6.2.9.15a, 6.2.9.16a, 6.2.9.22. In each of these paragraphs change "VERB 06 NOUN XX flashing" to "VERB 33 NOUN XX flashing."

Change 2: Paragraphs 6.2.20.2.2a, 6.2.20.2.4a, 6.2.20.2.7a, 6.2.20.2.10a, 6.2.20.2.13a, 6.2.20.2.16a, 6.2.20.2.19a, 6.2.20.2.22a, 6.2.20.2.25a, 6.2.20.2.28a, 6.2.20.2.31a, 6.2.20.2.34a, 6.2.20.2.37a, 6.2.20.3.8a, 6.2.20.3.11a, 6.2.20.3.14a, 6.2.20.3.17a, 6.2.20.3.20a, 6.2.20.3.24a, 6.2.20.3.27a, 6.2.20.3.31a, 6.2.20.3.34a, 6.2.20.3.37a, 6.2.20.3.40a; in each of these steps, change "V06" to "V33".

Change 3: Paragraph 6.2.16.7.19 Change FROM: On K-148 enter the following sequence:

VERB 21	NOUN 01	ENTR
00407		ENTR
77757		ENTR
VERB 21	NOUN 01	ENTR
00411		ENTR
00020		ENTR
VERB 33		ENTR

Change TO: On K-148 enter the following sequence:

VERB 21	NOUN 01	ENTR
02502		ENTR
77757		ENTR
VERB 21	NOUN 01	ENTR
02504		ENTR
00020		ENTR
VERB 33		ENTR

Change 4: Paragraph 6.2.16.7.33 Change FROM: On K-148 enter the following sequence:

VERB 21	NOUN 01	ENTR
00405		ENTR
00020		ENTR
VERB 21	NOUN 01	ENTR
00407		ENTR
77757		ENTR
VERB 33		ENTR

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ADDENDUM II

Change 4
(Continued)

Change TO: On K-148 enter the following sequence:

VERB 21	NOUN 01	ENTR
02500		ENTR
00020		ENTR
VERB 21	NOUN 01	ENTR
02502		ENTR
77757		ENTR
VERB 33		ENTR

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ADDENDUM III

SCOPE. The following changes are required to make ND1002325 applicable on G&N System technical support documentation for CSM 2TV-1.

Change 1: Make the changes as specified in Additions 11 through 20 of Addendum I.
Delete the following paragraphs from Addition 17: 6.2.13.5.1, 6.2.13.8.1,
6.2.13.17.1, 6.2.13.20.1.

APOLLO G&N Specification
ND 1002325

Original Issue Date:
Release Authority: TDRR 31414
Class *A* Release

POST INSTALLATION CHECKOUT PROCESS
SPECIFICATION FOR THE APOLLO GUIDANCE
AND NAVIGATION SYSTEM -- BLOCK II

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised

This specification consists of page 1 to 116 inclusive.

APPROVALS

NOT REQUIRED
PER
CCA497-0274
NASA/MSC

ACED

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1. INTRODUCTION

1.1 The individual Spacecraft (SC) installed Guidance and Navigation (G&N) System to be checked out per this process specification shall consist of one of each of the following major assemblies: The applicable part numbers shall be determined by drawing No. 2014999.

1 - Optical Unit Assembly

1 - Navigation Base Assembly, Block II

1 - Inertial Measurement Unit (IMU) & FIPA Elect. Assy.

1 - Power and Servo Assembly (PSA)

1 - Apollo Guidance Computer Group

1 - G&N Interconnect Harness Assembly

1 - Signal Conditioner Assembly

1 - Display and Control Group (D & C)

1 - Coupling Data Unit

1.2 The G&N System herein shall be identified as a Block II system. The computer contains the SUNDIAL C or D program test ropes in the core rope memory.

2. SCOPE

2.1 This specification outlines the checkout requirements for the G&N System installed in the Apollo Command Module Spacecrafts.

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3. APPLICABLE DOCUMENT

3.1 Documents Required by This Specification

3.1.1 When the requirements of this specification conflict with the drawing requirements, the drawing requirements shall have precedence.

PS 2015000	Master End Item Specification, Part II, Product Configuration and Acceptance Test Requirements, G&N Spacecraft Equipment Command Module, Block II
ICD MH01-01307-216	CDU to TVC Servo Amps Electrical Block II
ICD MH01-01324-216	Attitude Error Signals Electrical Block II
ICD MH01-01325-216	Total Attitude Signals
ICD MH01-01327-216	G&N Electrical Input Power
ICD MH01-01328-216	G&N Data Transmission to Operational and Flight Qual. Telemetry
ICD MH01-01342-216	G&N System Caution and Warning System Interface
ICD MH01-01349-416	G&N Thermal Requirements for Block II AGE
ICD MH01-01344-216	Mode Control Signals S/C to ISS Discretes
ICD MH01-01335-200	Electrical Inertial Temperature Controller
ICD MH01-01380-216	Command Module Guidance Computer Electrical Interfaces Block II
ICD MH01-01386-216	Attitude Error to SIVB
MH01-01390-200	G&N PSA Adapter Module ACE-S/C DTMS and DTCS Block II Vehicles.
MA0201-5108	ACE-S/C Computer Subprogram Program Requirements 2TV1, NAA
MA0308-0107	Mechanical Installation Specification for Apollo Guidance Equipment 2TV1
MA0610-018A	Contamination Control - Apollo Command Module and Service Module
SID 65-1642	Apollo Command Module/Service Module Measurement Requirements for Block II

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4.0 MATERIAL AND EQUIPMENT

4.1 The following test equipment shall be used to perform the requirements of this specification. If protection to personnel and equipment is not decreased, items, except government furnished parts, equivalent to those listed may be used.

ITEM	QUANTITY	DESCRIPTION
1	1	Digital Test Measurement System Model No. C14-206
2	1	Digital Test Command System, Model No. C14-207
3	1	Data Interleaver System, Model No. C14-232
4	1	External Digital Test Command Unit Model No. C14-231
5	1	S/C Ground Power Supply Model No. C14-418
6	1	Breakout Box, Test, Cm-SM Adapter Model No. C14-467
7	1	Electrical Cable Set, Model No. C34-391
8	1	Inertial Components Temperature Controller (ICTC) Model No. 513-100
9	1	PBA Adapter Module, Model No. A23-304
10	1	Optics Supporting Fixture Model No. A14-135
11	1	G&M Installation Qualification Fixture, Model No. A23-097
12	1	Theodolite (DKM 3 or equivalent) Model No. A23-079).
13	1	Retroreflecting Prism, Model No. A23-200
14	1	Portable Light Assembly Model No. A23-196
15	1	Vacuum Tube Volt Ohmmeter (VTVOH)
16	1	Calculator (Friden or equivalent).
17	1	Movable Optics Target
18	1	SCT Resolution Check Card
19	1	Electrical Cable Portable G&M System, Model No. C14-462
20	1	Electronic Counter with Preset Counter (Hewlett Packard 5245L with 526A Preset Plug-In Unit, or equivalent)
21	1	Cable Set
22	1	Stopwatch

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5.0 GENERAL REQUIREMENTS

5.1 Safety Requirements

5.1.1 Operator Safety

5.1.1.1 Normal Safety precautions shall be observed throughout the G&N post-installation checkout.

5.1.2 Equipment Safety

5.1.2.1 To preserve the operational life of the components of the G&N hardware under test, settings and adjustments shall be performed only when specified in the test procedure. Care shall be exercised in the accomplishment of all settings and adjustments to avoid excessive wear or damage to the equipment. All precautionary measures stated throughout the test procedures shall be strictly adhered to.

5.1.2.2 Prior to the electrical connection of the G&N System to the spacecraft harness, a complete verification of spacecraft power to include both voltage polarity and magnitude, shall be completed to preclude damage to the G&N due to incorrect power application.

5.1.2.3 In no event shall the Inertial Components Temperature Controller (ICTC) be disconnected from connector 45J2 of the PSA except when specified to do so in a specific test.

5.1.2.4 The generation of a noise alarm indication, as evidenced by one or more Noise Peak Event lights becoming lighted, shall be cause for immediate determination of effects on the G&N System Test in progress. In the event of detrimental effects on the system test, trouble shooting procedures shall be initiated to determine the cause of the alarm. Testing shall continue only after demonstrating that the cause of the noise alarm has been located and that remedial action has been or will be taken, or that the transient or noise causing the alarm has no detrimental effect on the G&N System or test in progress.

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- 5.1.2.5 Failure of the G&N System to pass any examination or test specified herein shall tentatively classify the G&N System as nonconforming. The normal test sequence may be continued on determination of the cause of the ~~nonconformance~~ if not detrimental to the G&N System on other interfacing subsystems. This determination shall have the concurrence of the G&N contractor test team. All nonconformance shall be investigated and cleared by waiver (FNN), correction of test specification, or hardware replacement. The suspected malfunctioning hardware shall be removed and returned to the laboratory, where the malfunction shall be verified. Only after malfunction verification shall a flight certified replaceable unit be installed in the G&N System.
- 5.1.2.6 The G&N System shall be operating in STANDBY mode with AGC power applied for a minimum of two hours prior to torquing of inertial components. In the event STANDBY or AGC power is interrupted, an equivalent time period shall be allowed when power is restored before transfer to the OPERATE mode, except that when the interval of interruption exceeds two hours, a two-hour warmup period shall be mandatory. Exceptions to the above are noted in 6.2.5.2.
- 5.1.2.7 The interruption of +28 VDC power to the G&N System through the Main A and Main B power busses shall be cause for the Command Module G&N System operator to immediately initiate the Emergency shutdown procedure (6.1.4) to preclude damage to the G&N System.

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5.2 Standard Environmental Conditions

5.2.1 The G&N System shall be tested under Class 100,000 conditions as specified in process specification MA0610-018A, while installed and operating in the command module, except as noted below.

5.2.1.1 For periods of G&N testing with the optical heads and the eyepieces of the SCT and SXT of the C/M G&N uncovered, or with the eyepieces removed, the environment shall meet at least the Class 100,000 particle size and count.

5.2.1.2 With the optical heads covered and the eyepieces installed or covered on the optical components (SXT, SCT), the ambient environmental shall meet the following conditions for particle size and count. No more than 200,000 particles 0.5 micron or larger per cubic foot with no more than 1,400 particles 5.0 microns or larger per cubic foot.

5.2.2 The APOLLO G&N System shall interface with a qualified ECS distribution system which shall supply coolant fluid during STANDBY and OPERATE control modes with flow rates and inlet temperatures as specified in ICD ME01-01349-416.

5.3 Test Equipment Tolerances

5.3.1 Measurements and tolerances are specifications stated herein are basic G&N system performance specifications. Calibration data must be supplied to the Acceptance Checkout Equipment (ACE) for the Power and Servo Assembly Adapter Module (PSAAM) and Signal Conditioner Assembly (SCA) performance. Final tolerances must include PSAAM and Signal Conditioner stability uncertainties (see appendix 1) as well as ACE and ACE carry-on conditioning uncertainties. All uncertainties due to instrumentation shall be root sum squared with the basic subsystem tolerance to yield an acceptable tolerance for use when testing the G&N system in the spacecraft.

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5.4 Test Sequence

- 5.4.1 The test sequence normally should follow the steps outlined by paragraph numbers in Table I in the order specified, except for 6.2.5, Turn-On and Turn-Off procedure, which may be performed as the requirement arises. This normal order may be deviated from, if necessary, as long as the sequences shown in the flow chart of Figure I are followed.

TABLE I TEST SEQUENCE

Paragraph No.	Test Title
6.1.3	Prepower Application Tests (Part of G&M Installation OCP)
6.2.1	Application of Standby Power to G&M System
6.2.2	CMC Operational Test
6.2.3	Operate Power On Test
6.2.4	G&M Power Supplies Test
6.2.5	General Turn Off and Turn On Procedure
6.2.6	G&M Operational Test
6.2.7	Gimbal Friction Test
6.2.8	G&M Panel Brightness & Lamp Test
6.2.9	Semi-Automatic Mode Control Test
6.2.10	Zero Optics Test
6.2.11	Optics Coordinate Transformation Control Test
6.2.12	Optics Positional Accuracy Test
6.2.13	Optics Slew Rate Test
6.2.14	Stabilization Loop Step Response Test
6.2.15	IRIG Scale Factor Test
6.2.16	IMU Performance Test
6.2.17	Fine Alignment Test SXT-NB-IMU
6.2.18	Gyrocompassing Test
6.2.19	Voltage Margin Test
6.2.21	S/C Control & Display Test

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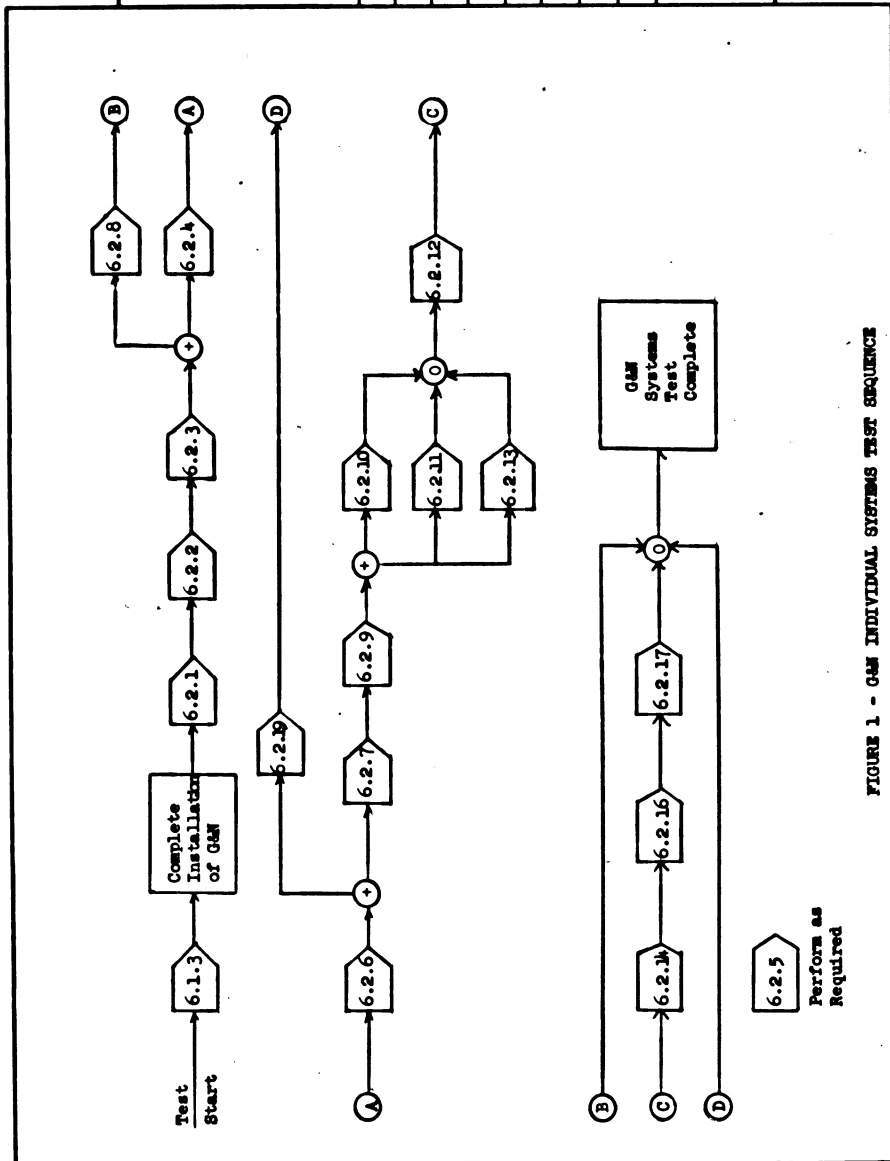


FIGURE 1 - GAN INDIVIDUAL SYSTEMS TEST SEQUENCE

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- 5.5 After the defective, replaceable element has been substituted with a flight certified unit, the G&N System checkout sequence shall regress to the rerunning of applicable portions of the selected sequence (by paragraph number) categorized by the subassemblies in which the malfunction occurred. The chosen subassembly categories are presented in Table II versus an appropriate retest paragraph sequence. Retest shall be conducted by performing applicable portions of all indicated paragraph numbers in the sequence listed as indicated under the appropriate subassembly heading. Retest shall proceed to the point in the normal test sequence at which the discrepancy was detected and corrected. Normal testing shall continue beyond this point in the specified sequence of Table I.
- 5.6 It is assumed that the Test Conductor has a working knowledge of the test equipment used; therefore, this procedure contains only the steps related directly to the G&N System components. If any questions arise concerning the test equipment, the Test Conductor should refer to the pertinent operational manuals.
- 5.7 The following requirements shall be completed before any of the tests in this specification are attempted.
- 5.7.1 The G&N System shall have been qualified in accordance with the requirements of PS 2015000.
- 5.7.2 The installation of the G&N System into the spacecraft shall have been completed as specified in Mechanical Installation Specification for Apollo Guidance Equipment Block II, MA0308-0107.
- 5.7.2.1 Interfacing systems (SCS, C & IS, EPS, ECS) shall have been verified to conform to loading and operational requirements as specified by the appropriate ICD.
- 5.7.3 All ACE equipment shall have been qualified in accordance with the respective quality assurance specifications prior to use with the G&N System.

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Table II. RETEST SEQUENCE

Paragraph Number	Test Title	IMU	Optics-Ray Base	AGC	PSA	IMB DSKY	MDC DSKY	Stg. Cond.	CDU	GSM Harness	PIPA Elect.	Indicator Control Panel
6.1.3	Pre-Power Application Tests	X		X								
6.2.1	Application of Standby Power to GSM System	X										
6.2.5	General Turn Off and Turn On Procedure	X	X	X	X	X	X	X	X	X	X	X
6.2.3	Operate Power On Test	X	X	X	X	X	X	X	X	X	X	X
6.2.2	CMC Operational Test		X	X		X	X		X	X		
6.2.8	GSM Panel Brightness and Lamp Test		X			X	X		X	X		
6.2.6	GSM Operational Test	X		X	X	X	X		X	X		
6.2.10	Zero Optics Test											
6.2.13	Optics Slew Rate Test		X	X	X				X	X		
6.2.11	Optics Coordinate Transformation Control		X		X				X	X		
6.2.12	Optics Positional Accuracy Test		X		X				X	X		
6.2.9	Semi-Automatic Mode Control Test	X		X	X	X	X		X	X		
6.2.14	Stab Loop Step Response Test	X			X	X	X		X	X		
6.2.15	IRIG Scale Factor Test	X			X	X	X		X	X		
6.2.16	IMU Performance Test	X			X	X	X		X	X		
6.2.17	Fine Alignment Test	X			X	X	X		X	X		
6.2.19	Voltage Margin Test	X			X	X	X		X	X		
6.2.7	Gimbal Friction Test	X										
6.2.18	Gyrocompassing Test	X										
6.2.4	GSM Power Supplies Test	X	X	X	X	X	X		X	X		

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- 5.8 The following conditions are required for testing the G&N System.
- 5.8.1 Spacecraft systems other than the G&N System may be operating on a noninterfering basis while individual system checkout of the G&N System is being conducted.
- 5.8.2 The G&N System shall be supported by the Electrical Power System and Environmental Control System during operation in the Command Module. The Stabilization and Control System shall be connected to the G&N System during G&N operation in the Command Module for passive loading purposes if available.
- 5.8.3 During tests which interface with the Stabilization and Control System and the Central Timing System, operation of these systems shall be required.
- 5.9 The G&N System shall be tested per this specification after it is installed in the spacecraft. In the event that the installed system, or any assembly thereof, is removed from the spacecraft for modification, recycle, or any other reason, this process specification or pertinent portions of it shall be performed after the G&N System or assembly thereof, is reinstalled. Testing shall be limited to G&N System operation while actively connected to qualified spacecraft threshold systems, namely, the Electrical Power System (EPS), Environmental Control System (ECS), and Communication and Instrumentation System (C&IS) as much as possible. However, a minimum of combined and integrated system testing with the Stabilization and Control System (SCS), Central Timing System (CTS) and Caution and Warning System is required for complete G&N System verification.

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- 5.10 The test equipment listed in paragraph 4.1 shall be connected and ready for operation before the tests of this specification are initiated.
- 5.11 Data Records
- 5.11.1 All data concerning the checkout and operation of the G&N System as monitored via ACE, shall be recorded on the data sheets associated with their corresponding test. Out of tolerance readings shall be recorded and flagged by appropriate symbols.
- 5.11.1.1 All test data obtained while demonstrating the requirements of this document shall be permanently recorded and forwarded with the tested G&N to the next receiving agency.
- 5.11.1.2 A record of the amount of time each of the four prime power busses are on shall be kept and forwarded with the G&N to the next receiving agency.
- 5.12 Interface
- 5.12.1 The APOLLO G&N System shall interface with accepted ECS and EPS distribution systems for power and environment control purposes and with the SCS or SCS substitute system for signal interface in accordance with the applicable ICD's.

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6.0 DETAIL REQUIREMENTS

6.1 Initial Test Conditions

6.1.1 The following precautions shall be observed to preclude loss of continuity in inertial component performance history of the IMU. Deviation may necessitate recalibration of the inertial components.

6.1.1.1 The IMU shall be supplied with heater power on a continuous basis. When S/C Ground Power Supply, Model No. C14-418 is not providing heater power, then heater power shall be supplied through the Inertial Components Temperature Controller (ICTC) Model No. 513-100. The temperature of the IMU's shall be maintained between 120° and 150°F. The temperature of the PIPA's shall be maintained between 115° and 145°F.

6.1.1.2 The Standby Mode is identified by the circuit breakers IMU HTR MN A, IMU HTR MN B, COMPUTER MN A and MN B in the ON position and IMU MN A and MN B and the G&N Power-IMU switch on LEB Lighting Control Panel in the OFF position. The Operate Mode is identified by the circuit breaker IMU HTR MN A, MN B, COMPUTER MN A and MN B in the ON position and IMU MN A and MN B and the G&N Power-IMU switch on the LEB Lighting Control Panel in the ON position. The G&N System shall be operating in the Standby Mode with CMC power ON for a minimum of two hours prior to advancing to the IMU Operate Mode. In the event Standby or CMC power is interrupted, an equivalent time period shall be allowed when power is restored before advancing to the Operate Mode, except that when the interval of interruption exceeds two hours, a two-hour warmup period shall be mandatory (exceptions to the 2-hour warmup are noted in 6.2.5.2).

6.1.1.3 The Inertial Measurement Unit shall not be without heater power for more than 15 minutes.

6.1.1.4 During the turn on of the G&N power, COMPUTER MN A and MN B and IMU HTR MN A and IMU HTR MN B circuit breakers must be turned on before the IMU MN A and IMU MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. During the turn off of the G&N power the IMU MN A and IMU MN B circuit breakers must be turned off before the IMU HTR MN A and IMU HTR MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. In no case shall COMPUTER MN A and MN B circuit breaker be turned off before IMU MN A and MN B circuit breakers.

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- 6.1.1.5 A warmup period of 1 hour with OPERATE power applied shall be required prior to performing any test in which gyre and accelerometer parameters are measured, and 15 minutes warmup prior to any test in which precision amplitude and frequency power supply checks are made.
- 6.1.1.6 The following Command Module switches shall be in the position shown unless specifically directed otherwise in a procedural function.
- UP TIM switches on the LEB G&N Control Panel and MDC Panel 2 shall be set to ACCEPT.
 - LAUNCH VEHICLE - GUIDANCE switch on MDC Panel 2 shall be set to IV.
 - The SC CONT switch on MDC Panel 1 shall be set to CMC.
 - The CMC MODE switch on MDC Panel 1 shall be set to AUTO.
 - The Δ V CG switch on MDC Panel 1 shall be set to CSM.
 - The TRACKER switch on G&N Indicator Control Panel shall be set to OFF.
 - The LIGHTS-INTEGRAL control on the LEB Lighting Control Panel and the Left Hand Circuit Breaker panel shall be set to the minimum brightness - OFF position.
- 6.1.2 The following optical reference alignment requirements shall be demonstrated.
- 6.1.2.1 G&N Installation Qualification Fixture
- 6.1.2.1.1 The SXT Optical Reference No. 1 (Azimuth Antiset) LOS shall be located approximately 45 degrees (CW when viewed from above) from the SCZ axis measured in a horizontal plane. At this position, the Optical Reference shall be capable of being viewed through the SXT ST LOS.
- 6.1.2.1.2 The SXT Optical Reference LOS position with respect to the horizontal plane shall be known to within 5 arc-seconds. The azimuth bearing of the Optical Reference LOS shall be known to within ± 30 minutes of arc.
- 6.1.2.1.3 The SXT Optical Reference No. 2 LOS shall be located approximately 90 degrees from the SXT Optical Reference No. 1 (45 degrees from S/C Z axis) measured in a horizontal plane. At this position, the Optical Reference shall be capable of being viewed through the SXT BEAR LOS.

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- 6.1.2.1.3.1 The SXT optical reference LOS position with respect to the horizontal plane shall be known to within 5 arc-seconds. The angle between Optical Reference No. 1 and No. 2 shall be known to within +30 seconds of arc.
- 6.1.2.1.4 SXT Optical Reference No. 3 shall be capable of being viewed through the SXT LIOS and the STAR LOS simultaneously at the Zero Optics position.
- 6.1.2.1.4.1 SXT Optical Reference No. 3 shall have the capability to measure the nonparallelism of the LIOS and STAR LOS to a resolution of 2 arc-seconds.

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6.1.3 Prepower Application Requirements

6.1.3.1 Prior to connecting G&N power connectors 56P30 and 56P31 to spacecraft power connectors C03WLJ345 and C03WLJ346, respectively, it is necessary to perform a complete verification of spacecraft power. Verification shall be performed with the installation of the G&N System complete except for connection of 56P30 and 56P31 to the S/C connectors.

6.1.3.2 Resistance Check on S/C Power Connectors.

6.1.3.2.1 Insure that the following switches and circuit breakers are set to the position indicated.

- a. GUIDANCE/NAVIGATION POWER AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- b. GUIDANCE/NAVIGATION IMU MW A and MW B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- c. GUIDANCE/NAVIGATION IMU HTR MW A and MW B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- d. GUIDANCE/NAVIGATION COMPUTER MW A and MW B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- e. GUIDANCE/NAVIGATION OPTICS MW A and MW B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).
- f. G/N POWER switch on the Right Hand Circuit Breaker Panel to OFF.
- g. G/N POWER-OPTICS switch on the LES Lighting Control Panel to OFF.
- h. G/N POWER - IMU switch on the LES Lighting Control Panel to OFF.

6.1.3.2.2 Obtain GSE tool consisting of connectors, extension cables, and connector terminal test box. Mate connectors P1 and P2 of the extension cables with S/C power connectors C03WLJ345 and C03WLJ346 respectively. Using a VIVOM measure the resistance between the terminals listed in Table I. Resistance measurements shall be as specified in Table I.

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TABLE I. RESISTANCE REQUIREMENTS FOR S/C POWER CONNECTORS

<u>Test No.</u>	<u>From</u>	<u>To</u>	<u>Requirements</u>
1	P1-2	P2-18	Open
2	P1-5		
3	P1-6		
4	P1-7		
5	P1-8		
6	P1-9		
7	P1-10		
8	P1-11		
9	P1-12		
10	P1-13		
11	P1-14		
12	P1-17		
13	P2-2		
14	P2-5		
15	P2-6		
16	P2-7		
17	P2-8		
18	P2-9		
19	P2-10		
20	P2-11		
21	P2-12		
22	P2-13		
23	P2-14		
24	P2-17		
25	P1-1	P1-18	Continuity
26	P1-3		
27	P1-4		
28	P1-15		
29	P1-16		
30	P2-1		
31	P2-3		
32	P2-4		
33	P2-15		
34	P2-16		

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6.1.3.3 Polarity and Voltage Check on S/C Power

6.1.3.3.1 Perform a voltage and polarity check of the G&N S/C power by performing the measurements indicated in Table II. Set the following switches to the position indicated.

- G/N POWER-OPTICS switch on the LES Lighting Control Panel to ON.
- G/N POWER - IMU switch on the LES Lighting Control Panel to ON.
- G/N POWER switch on the Right Hand Circuit Breaker Panel to ACZ.

For each measurement in Table II set the indicated circuit breaker on the Right Hand Circuit Breaker Panel to ON (breaker pushed in). After each measurement return the circuit breaker to OFF (breaker pulled out).

TABLE II. POLARITY & VOLTAGE REQUIREMENTS
FOR S/C POWER.

Test No.	Circuit Breaker	Polarity & Connector		Requirements
		Pin No.		
		Low	High	
1	COMPUTER MN A	P1-1	P1-2	+28.8 \pm 3VDC
2	OPTICS MN A	P1-14	P1-7	+28.8 \pm 3VDC
3	IMU MN A	P1-15	P1-9	+28.8 \pm 3VDC
		P1-16	P1-10	+28.8 \pm 3VDC
4	IMU HTR MN A	P1-3	P1-8	+28.8 \pm 3VDC
5	COMPUTER MN B	P2-1	P2-2	+28.8 \pm 3VDC
6	OPTICS MN B	P2-14	P2-7	+28.8 \pm 3VDC
7	IMU MN B	P2-15	P2-9	+28.8 \pm 3VDC
		P2-16	P2-10	+28.8 \pm 3VDC
8	IMU HTR MN B	P2-3	P2-8	+28.8 \pm 3VDC
9	POWER AC 1	P1-18	P1-17	115 \pm 10 VAC 400 \pm 7 cps
Set G/N POWER switch on the Right Hand Circuit Breaker Panel to AC 2.				
10	POWER AC 2	P1-18	P1-17	115 \pm 10VAC 400 \pm 7 cps

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6.1.3.3.2 Verify all circuit breakers exercised in Table II are in the OFF position (breakers pulled out). Set the following switches to the OFF position.

- a. G/N POWER - OPTICS switch on the LEB Lighting Control Panel.
- b. G/N POWER - DMU switch on the LEB Lighting Control Panel.
- c. G/N POWER switch on the Right Hand Circuit Breaker Panel.

6.1.3.3.3 Disconnect connectors P1 and P2 of the test cables from S/C connectors C03WLJ345 and C03WLJ346, respectively.

6.1.3.4 Resistance Check on G&N Power Connectors

6.1.3.4.1 Connect test cable connectors J1 and J2 to G&N connectors 56P30 and 56P31, respectively. Using a VIVOM, measure the resistance between the terminals listed in Table III. The measurements shall meet the requirements listed in Table III.

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TABLE III. RESISTANCE REQUIREMENTS FOR G&N
POWER CONNECTORS

Test No.	From	To	Requirements (ohms)	Results
1	J1-15	J1-6	1000 to infinity	
2	J1-15	J1-14	1000 to infinity	
3	J1-15	J1-1	1000 to infinity	
4	J1-15	J1-18	5 meg to infinity	
5	J1-15	J1-16	0.0 to 0.5	
6	J1-15	J1-3	0.0 to 0.5	
7	J1-15	J2-15	0.0 to 0.5	
8	J1-14	J2-14	0.0 to 0.5	
9	J1-1	J2-1	0.0 to 0.5	
10	J1-6	J2-6	0.0 to 0.5	
11	J1-16	J2-16	0.0 to 0.5	
12	J1-3	J2-3	0.0 to 0.5	
13	J1-14	J1-6	1000 to infinity	
14	J1-1	J1-14	1000 to infinity	
15	J1-1	J1-6	0.0 to 2.0 infinity	
16	J1-18	J1-6	5 meg to infinity	
17	J1-18	J1-14	5 meg to infinity	
18	J1-18	J1-1	5 meg to infinity	
19	J1-2	J1-1	2.8 to infinity	
20	J1-9	J1-15	1.1 to infinity	
21	J1-10	J1-16	1.1 to infinity	
22	J1-7	J1-14	2.8 to infinity	
23	J1-8	J1-3	3.7 to infinity	
24	J1-17	J1-18	5 to infinity	
25	J2-2	J2-1	2.8 to infinity	
26	J2-9	J2-15	1.1 to infinity	
27	J2-10	J2-16	1.1 to infinity	
28	J2-7	J2-14	2.8 to infinity	
29	J2-8	J2-3	3.7 to infinity	

6.1.3.5

Disconnect the test cable connectors J1 and J2 from G&N power connectors 56P30 and 56P31, respectively. Mate G&N connector 56P30 to S/C connector C03WLJ345 and mate G&N connector 56P31 to S/C connector C03WLJ346. Mate G&N connector 56P32 to S/C connector C03WLJ347.

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6.1.4 Emergency Shutdown Procedure

CAUTION: In the event of a malfunction occurrence which could damage the G&N System before the normal shutdown procedure 6.2.5 could be performed, the following sequence should be utilized in the spacecraft.

6.1.4.1 On the LES Lighting Control Panel set the G/N POWER-IMU and G/N POWER - OPTICS switches to OFF.

6.1.4.2 On the Right Hand Circuit Breaker Panel set the following switches and circuit breakers to OFF (breakers pulled out).

- a. GUIDANCE/NAVIGATION COMPUTER ME. A and ME B
- b. GUIDANCE/NAVIGATION IMU HTR ME A and ME B
- c. G/N POWER switch to OFF
- d. GUIDANCE/NAVIGATION IMU ME A and ME B
- e. GUIDANCE/NAVIGATION OPTICS ME A and ME B
- f. GUIDANCE/NAVIGATION POWER AC 1 and AC 2

6.1.4.3 Verify that the ICTC is providing heater power to the G&N System.

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6.2 Test Procedures

6.2.1 Application of Standby Power to G & N System

- 6.2.1.1 Verify that spacecraft power checks, to include polarity and magnitude on Spacecraft Power Connector, have been made as specified in 6.1.3.
- 6.2.1.2 All power and control switches on the G & N Indicator Control Panel shall be placed in the OFF or neutral position.
- 6.2.1.3 The Inertial Component Temperature Controller (ICTC), shall be supplying inertial component heater power to the G & N System through the PSA, Connector No. 45J2.
- 6.2.1.4 Computer Power On
- 6.2.1.4.1 Set G & N COMPUTER MW A and MW B Breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in).
- 6.2.1.4.2 Set the POWER-ACL and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in), and position G/N POWER switch to ACL.
- 6.2.1.4.3 Set the computer numerical display lights to the minimum acceptable brightness by rotating the BRIGHTNESS Controls on the MDC and LEB Lighting Control Panels.
- 6.2.1.4.4 The CMC +28 VDC power discrete shall be issued (CG 1523). This can be observed by the lighted CMC +28 VDC operate lamp on the Event Module. The +28 VDC CMC OPERATE voltage (CG 1520) shall be $+26.8 \pm 3$ VDC. Verify CRT indication.
- 6.2.1.4.5 Using DSKY, enter VERB 36, ENTR, then press RESET. All computer alarms on the Main Display Console (MDC), LEB CMC DSKY and CRT shall clear.
- 6.2.1.4.6 The voltage output of the +4 VDC CMC supply shall be $+4.00 \pm 0.20$ VDC, (CG 1030). The value on the CRT shall be recorded.
- 6.2.1.4.7 The voltage output of the +14 VDC CMC supply shall be $+14.0 \pm 0.4$ VDC, (CG 1020). The value on the CRT shall be recorded.
- 6.2.1.4.8 Verify that the CMC is in the Backup Mode by monitoring on the CRT that the Program indicates 00, and the program readouts on the MDC and LEB AGC DSKY indicate 00.

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6.2.1.4.9 Zero the CMC erasable memory by entering the following sequence into the K-start:

- a. VERB 57, ENTER
- b. 00015, ENTER

6.2.1.4.10 Initiate CMC self-check by entering the following sequence into the K-start:

- a. VERB 21
- b. NOUN 27, ENTER
- c. 77777, ENTER

Wait 5 minutes then -

6.2.1.4.10.1 Verify that R1 does not display 01102 or 41102. If an error is detected, the following will be displayed:

R1 = 01102 or 41102
R2 = XXXXX e (sFail)
R3 = XXXXX e (ERcount)

6.2.1.4.10.2 Enter the following into the K-start:

- a. VERB 21
- b. NOUN 27, press ENTER pushbutton
- c. 00000, press ENTER pushbutton

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6.2.1.5 IMU HTR Heater Power On

6.2.1.5.1 Enter the IMU Standby Mode of operation by engaging the IMU HTR MW A and MW B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).

6.2.1.5.2 Verify that the IMU +28 VDC STANDBY discrete lamp on Event Module is illuminated (CG 1513).

6.2.1.5.3 Record the value of the following signals displayed on the CRT.

Signal	Requirement
a. CG 1331 28V 3200 CPS POWER SUPPLY FEEDBACK	28.6 ± 0.6 VRMS
b. CG 1510 + 28 VDC STANDBY POWER	28.8 (±3) VDC

6.2.1.5.4 The PIPA TEMP on the CRT shall be monitored at 15 min., 1 hr. and 2 hrs. from execution of 6.2.1.5.2 to insure that the PIPA Temperature Control Loop circuitry is operating to maintain a temperature of $130.5 \pm 1.5^\circ$ (CG 2300).

6.2.1.5.5 The IRIQ TEMP on the CRT shall be monitored at 15 min., 1 hr., and 2 hrs. after 6.2.1.5.2 is executed to insure that the IRIQ Temperature (CG 2301) is within 3.0 degrees of the PIPA Temperature.

6.2.1.5.6 At the termination of the 2-hour period, record the PIPA Temperature (CG 2300) and the IRIQ Temperature (CG 2301) on the CRT.

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6.2.2 CMC Operational Test

NOTE: This test shall be performed when only IMU HTR and Computer Power is applied. The test shall not be performed when IMU OPERATE power is applied.

6.2.2.1 Verify that IMU STANDBY power (including CMC operate power) is applied, IMU OPERATE power is not applied. (G & H IMU HTR MN A and MN B breakers engaged, Computer MN A and MN B breakers engaged, IMU MN A and MN B breakers disengaged, G/H Power-IMU switch on LEB Lighting Control Panel in OFF Position).

6.2.2.1.1 Using the LEB CMC DSKY, enter VERB 36, ENTER then press RESET.

6.2.2 CMC Checks

6.2.2.1 Using the LEB CMC DSKY, enter the following sequence of data into the CMC to initiate the DSKY check. Press the ENTER pushbutton after each entry (denoted by E).

VERB 21 NOUN 27, E
77766, E

6.2.2.2 DSKY check shall check all the electroluminescent elements by displaying the decimal numbers from nine through zero in succession, each set of numbers shall be displayed for approximately 5 seconds. Verify all elements operable on MDC and LEB CMC DSKY's. VERB-NOUN display shall flash.

6.2.2.2.1 Minus and plus signs shall be displayed. Verify operation on MDC and LEB DSKY's.

6.2.2.2.2 COMP ACTY lamp shall be illuminated for approximately 5 seconds, then DSKY shall blank.

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6.2.2.3 CAUTION and STATUS Displays**6.2.2.3.1 Enter VERB 35, ENTER, into LEB CMC DSKY.****6.2.2.3.2 The following MDC and LEB CMC DSKY displays shall illuminate for approximately 5 sec.nds.**

- a. UPLINK ACTY
- b. NO ATT
- c. STBY
- d. KEY REL Flashing
- e. TEMP
- f. GIMBAL LOCK
- g. PROG
- h. RESTART
- i. TRACKER
- j. OPR ERROR Flashing
- k. COMP ACTY
- l. VERB-NOUN Flashing
- m. Plus 88888 in R1, R2, and R3

After indications a through l go out +88888 shall remain in R1, R2, R3.

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6.2.2.4 DSKY Pushbutton Check

6.2.2.4.1 Enter the following sequence into the LEB CMC DSKY. Press the ENTER pushbutton after each entry (denoted by E).

- a. VERB 25 NOUN 01, E
- b. 01600, E
- c. +00123, E
- d. -00456, E
- e. -00789, E

6.2.2.4.2 The LEB CMC DSKY shall indicate +00123 in R1, -00456 in R2, and -00789 in R3.

6.2.2.4.3 Enter VERB 05, NOUN 01 into the LEB CMC DSKY. Press the ENTER pushbutton.

6.2.2.4.4 Enter 01600 into LEB CMC DSKY. Press the ENTER pushbutton. The LEB CMC DSKY shall indicate 00024 in R1, 77664 in R2, and 77576 in R3. Verify.

6.2.2.4.5 Repeat of 6.2.2.4.1 through 6.2.2.4.4 using the MDC CMC DSKY. The results shall be as specified in 6.2.2.4.4.

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6.2.2.5 Uplink and Downlink Checks.

6.2.2.5.1 Enter VERB 36 into K148. Press the ENTER pushbutton, then press ERROR RESET pushbutton.

6.2.2.5.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.

- a. VERB 25 NOUN 01 ENTER
- b. 01600, ENTER
- c. 00000, ENTER
- d. TTTTT, ENTER
- e. 07254, ENTER
- f. VERB 05 NOUN 01, ENTER
- g. 01600, ENTER

6.2.2.5.3 CMC Registers R1, R2, and R3 display on the CRT shall indicate 00000, TTTTT, and 07254, respectively.

6.2.2.6 CMC Automatic Self-Test

6.2.2.6.1 Initiate the CMC Automatic Self-Test by entering the following sequence into K148. Press the ENTER pushbutton after each entry.

VERB 21, NOUN 27, ENTER
TTTTT, ENTER

Wait 5 minutes -

6.2.2.6.2 Verify that R1 does not display 01102 or 41102. If an error is detected, the following will be displayed:

VERB 05 NOUN 31
R1 = 01102 or 41102
R2 = XXXXX c (S Fail)
R3 = XXXXX c (ERcount)

6.2.2.6.3 Enter the following into the R - Start:

- a. VERB 21 NOUN 27, press ENTER pushbutton
- b. 00000, press ENTER pushbutton

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6.2.2.7 Parity Fail Test

6.2.2.7.1 Enter the following into the K-Start. Press the **ENTER** pushbutton after each entry.

- a. VERB 57, **ENTER**
- b. 00015, **ENTER**
- c. VERB 21 NOUN 02, **ENTER**
- d. 01600, **ENTER**
- e. 33777, **ENTER**
- f. VERB 25 NOUN 26, **ENTER**
- g. 04000, **ENTER**
- h. 01600, **ENTER**
- i. 00003, **ENTER**
- j. VERB 30, **ENTER**

The RESTART lamps on the MDC & LEB DSKY's shall illuminate.
The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.7.2 Press the **ERROR RESET** pushbutton on the K-Start. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.7.3 Enter VERB 36, into the K-START. Press the **ENTER** pushbutton.

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6.2.2.8 Rupt Lock Test

6.2.2.8.1 Enter the following sequence into the K-Start. Press the ENTER pushbutton after each entry.

- a. VERB 24 NOUN 01, ENTER
- b. 01600, ENTER
- c. 30001, ENTER
- d. 01600, ENTER
- e. VERB 25 NOUN 26, ENTER
- f. 00001, ENTER
- g. 01600, ENTER
- h. 00003, ENTER
- i. VERB 31, ENTER

The RESTART lamps on the MDC and LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.8.2 Press the ERROR RESET pushbutton on the K-START. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.8.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

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6.2.2.9 TC Trap Test

6.2.2.9.1 Enter the following sequence into the K-Start. Press the **ENTER** pushbutton after each entry.

- a. VERB 21 NOUN 02, **ENTER**
- b. 01600, **ENTER**
- c. 01600, **ENTER**
- d. VERB 25 NOUN 26, **ENTER**
- e. 04000, **ENTER**
- f. 01600, **ENTER**
- g. 00003, **ENTER**
- h. VERB 30, **ENTER**

The **RESTART** lamps on the MDC & LEB DSKY's shall illuminate.
The **PGNS** caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.9.2 Press the **ERROR RESET** pushbutton on the K-Start. The **RESTART** & **PGNS** caution lamps shall extinguish.

6.2.2.9.3 Enter VERB 36 into the K-Start. Press the **ENTER** pushbutton.

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6.2.2.10 Nightwatchman Test

6.2.2.10.1 Enter the following sequence into the K-Start. Press ENTER pushbutton after each entry.

- a. VERB 24 NOUN 01, ENTER
- b. 01600, ENTER
- c. 30001, ENTER
- d. 01600, ENTER
- e. VERB 25 NOUN 26, ENTER
- f. 04000, ENTER
- g. 01600, ENTER
- h. 00003, ENTER
- i. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate.
The PONS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on MDC and LEB CMC DSKY and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.10.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PONS caution lamps shall extinguish.

6.2.2.10.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

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6.2.2.11 GNC Clock Frequency Test

6.2.2.11.1 Insure that the AGC has been operating for at least 15 min. before performing this test.

6.2.2.11.2 Insure that the IMU 3.2 kc 28 V Supply is available on the vertical input to FIPA Scope.

6.2.2.11.3 Insure that the EPUT Meter and preset counter plug-in unit are connected to 115V, 60 cps power.

6.2.2.11.3.1 Permit the EPUT to warm up for the length of time required by the manufacturer's specification.

6.2.2.11.4 Connect the signal output from Oscilloscope 4A4-A1 to the input channel on the EPUT Meter.

6.2.2.11.5 Set the preset counter to indicate 96000.

6.2.2.11.6 Set the EPUT meter to count at the maximum count rate (1 megacycle or greater).

6.2.2.11.7 Adjust the Trigger Level to the point midway between the range over which the counter will normally count.

6.2.2.11.8 Each count cycle shall last approximately 30 seconds. Adjust the display time to permit recording the display on the EPUT.

6.2.2.11.9 Record the results of 10 count-cycles. Calculate the average time per cycle over the 10 cycles. Record the result.

6.2.2.11.10 Divide 96000 by the average time from 6.2.2.11.9. Record the result as 3200 cps frequency.

6.2.2.11.11 Multiply the 3200 cps frequency by 640. Record the result as the AGC clock frequency.

6.2.2.11.11.1 The AGC Clock Frequency shall be 2048000 ± 5 cps.

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6.2.3 Operate Power On Test**6.2.3.1 IMU Operate Power On**

CAUTION: The sequences specified in this test must be adhered to. Deviations may necessitate recalibration of the inertial components.

NOTE: Disregard the GIMBAL LOCK indicator until the completion of step 6.2.3.1.6.

6.2.3.1.1 The following Command Module switches and circuit breakers shall be in the following state:**Right Hand Circuit Breaker Panel**

- a. GUIDANCE/NAVIGATION COMPUTER MN A and MN B breakers on (pushed in)
- b. GUIDANCE/NAVIGATION IMU HTR MN A and MN B breakers on (pushed in)
- c. GUIDANCE/NAVIGATION IMU MN A and MN B breakers off (pulled out)
- d. GUIDANCE/NAVIGATION OPTICS MN A and MN B breakers off (pulled out)

LEB Lighting Control Panel

- e. G/N Power - IMU set to OFF
- f. G/N Power - Optics set to OFF

6.2.3.1.2 Switches and selectors on the G & N Indicator control panel shall be set as follows:

- a. OPTICS MODE to MANUAL
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to MED
- d. TELESCOPE TRUNNION to SLAVE to EXT
- e. RETICLE BRIGHTNESS to minimum brightness position

6.2.3.1.3 Adjust the Command Module MDC and LEB Lighting Controls to minimum intensity for proper readout of G & N Displays.

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6.2.3.1.4 Set up the ACE analog recorders to monitor the following measurements (set chart speed to 5 mm/sec):

- a. CG 2117 IGA Servo Error In Phase
- b. CG 2177 OGA Servo Error In Phase
- c. CG 2147 MGA Servo Error In Phase
- d. CG 2112 IG IX Resolver Output Sin
- e. CG 2172 OG IX Resolver Output Sin
- f. CG 2142 MG IX Resolver Output Sin
- g. CG 1040 +120 VDC PIPA Supply DC Level

CAUTION: Before proceeding, insure that the G & N System has been operating in the STANDBY MODE (power configuration as defined in 6.2.3.1) for a minimum period of 2 hours. Exceptions to this requirement are noted in 6.2.5.2.9.

CAUTION NOTE: If the requirements of 6.2.3.1.6 are not met, remove DMU operate power immediately by placing the G/N POWER-DMU switch on the LEB Lighting Control Panel to OFF.

6.2.3.1.5 Perform the following sequence:

- a. Turn on the DMU MW A and MW B circuit breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).
- b. Start Analog Recorders.
- c. Place G/N Power - DMU switch on the LEB Lighting Control Panel to ON (switch toggle up).

6.2.3.1.6 Immediately begin monitoring the following measurements.

- a. The DMU Operate Power is $+28.8 \pm 3\text{VDC}$ (CG 1500). Verify on CRT.
- b. On the recorders, verify that oscillations are not sustained and that a null is achieved within 10 seconds of power application in 6.2.3.1.5 on the following measurements:

CG 2112, IG IX Resolver Output Sin
CG 2142, MG IX Resolver Output Sin
CG 2172, OG IX Resolver Output Sin

- c. On the CRT, verify the absence of the +120 VDC PIPA supply (CG 1040) for a period of 90 + 10 seconds following power application in 6.2.3.1.5. After approximately 100 seconds, the voltage shall read $+120 \pm 6\text{VDC}$.

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6.2.3.1.7 Insure that the following alarm lamps are not lighted on G & N LEB Display Panel.

- a. CMC Warning
- b. ISS Warning
- c. PQMS Caution

6.2.3.1.8 Verify that the PROGRAM ALARM lamp on the DEKY's does not light with VERB 05 NOUN 31 and R1 = 00213 displayed.

6.2.3.1.9 The CG, IG, and MG CDU angles shall be 00000 \pm 00150. Verify on CRT.

6.2.3.1.10 Verify that the following secondary power supply voltages are not flashing on the CRT display.

Table VI. Secondary Power Supply Voltages

Meas. No.	Signal
1 CG 1040	+120 VDC PIPA SUPPLY
2 CG 1051	+20 VDC PIPA SUPPLY
3 CG 1052	-20 VDC PIPA SUPPLY
4 CG 1070	+4 VDC CDU SUPPLY
5 CG 1100	-28 VDC ELECTRONICS
6 CG 1020	+14 VDC CMC SUPPLY
7 CG 1030	+4 VDC CMC SUPPLY
8 CG 1201	IMU 28 V 800 CPS 1 pct 0 ph
9 CG 1202	IMU 28 V 800 CPS 5 pct ph A
10 CG 1203	IMU 28 V 800 CPS 5 pct ph B
11 CG 1331	3.2KC 28 V SUPPLY
12 CG 1110	2.5 VDC TM BIAS

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6.2.3.2 Optics Power On

6.2.3.2.1 Optics power shall be applied by actuating the G & N OPTICS MW A and OPTICS MW B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in), and placing G/N Power -OPTICS switch on the LES Lighting Control Panel to ON.

6.2.3.2.2 OPTICS +28 VDC discrete shall be issued (CG 1533). Verify by observing that the OPTICS lamp on Event Module is illuminated. Verify that the +28 VDC OPTX OPERATE BUS (CG 1530) is $+28.8 \pm 3$ VDC. Record the indication on the CRT.

6.2.3.2.3 Verify the following secondary power supply voltages on the CRT are not flashing:

CG 1211 OPTX 28 V 800 CPS 1 pct 0 ph
CG 1212 OPTX 800 CPS 5 pct-90ph

6.2.3.3 Enter and verify VERB 40 NOUN 20 into Kl48. Press the ENTER pushbutton to advance the system to the Zero CDU mode.

6.2.3.4 Enter and verify VERB 41, NOUN 20 into Kl48. Press the ENTER pushbutton to advance the system to Coarse Align under CMC control. The VERB NOUN display on CRT shall flash and indicate 21-22.

6.2.3.5 Enter and verify +00000 into Kl48 three times, pressing the ENTER pushbutton after each entry.

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6.2.4 G & N System Power Supplies Test

6.2.4.1 Proceed with this test if 6.2.3, Operate Power On Test, has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding with this test. Insure that the IMU Operate Power has been on for at least 15 minutes before proceeding with this test.

6.2.4.2 Enter the following sequence into the K-Start. Verb 41 NOUN 20, ENTER; +00000 ENTER; +00000 ENTER, +00000 ENTER.

6.2.4.3 Insure that OPERATE power has been applied for at least 15 minutes. Verify that the discretes listed below have been issued by noting that the event lamps on the specified Event Module are illuminated.

- a. IMU STANDBY POWER (CG 1513)
- b. CMC OPERATE POWER (CG 1523)
- c. OPTX OPERATE POWER (CG 1533)

6.2.4.4 The IRIG and PIPA Pulse Torque DC supply shall demonstrate the following requirements. The DC output voltages shall be as follows. Record the indicated voltages on the CRT.

- a. The 120 volt PIPA Power Supply output voltage shall be 120 ± 6 VDC (CG 1040).
- b. The PIPA +20 VDC Supply output voltage shall be $+20 \pm 1.2$ VDC (CG 1051).
- c. The PIPA -20 VDC output voltage shall be -20 ± 2 VDC (CG 1052).

6.2.4.5 The minus 28 VDC Electronics Power Supply output voltage shall be -27.5 ± 6.0 VDC (CG 1100). Record the indicated voltage displayed on the CRT.

6.2.4.6 Power Supplies

Record the indicated voltage display on the CRT.

- a. The +14 VDC CMC Power output voltage shall be $+14.0 \pm 0.4$ VDC (CG 1020).
- b. The +4 VDC CMC Power Supply output voltage shall be $+4.00 \pm 0.20$ VDC (CG 1030).
- c. The +4 VDC CDU Power Supply output voltage shall be $\pm 4.0 \pm 0.2$ VDC.

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6.2.4.7 Twenty-eight volt, 800 CPS Power Supplies - the following values shall be measured with the guidance reference clock synchronizing input pulses. Record the indicated voltage displayed on the CRT.

- a. IMU +28 V, 800 CPS 1 per cent 0 degree voltage shall be 28.0 ± 0.6 VAC (CG 1201).
- b. IMU 28 V, 800 CPS, 5 per cent Ph A -90 degree voltage shall be 28.0 ± 1.4 VAC (CG 1202).
- c. IMU +28 V, 800 CPS 5 per cent Ph B 0 degree voltage shall be 28.0 ± 2.1 VAC (CG 1203).
- d. Optics +28 V, 800 CPS 1 per cent 0 degree voltage shall be 28.0 ± 0.6 VAC (CG 1211).
- e. Optics +28 V, 800 CPS 5 per cent -90 degree voltage shall be 28.0 ± 1.5 VAC (CG 1212).

6.2.4.8 IMU 3200 CPS Supply

The 28 V 3200 CPS Supply feedback output voltage shall be 28.6 ± 0.6 volts RMS (CG 1331). Record the indicated voltage displayed on the CRT.

6.2.4.9 Plus 28 VDC Busses

Record the indicated voltage displayed on the CRT.

- a. The +28 VDC IMU OPERATE (Bus No. 1) output voltage shall be 28.8 (+3, -3) VDC under normal system load (CG 1500).
- b. The +28 VDC IMU STANDBY (Bus No. 2) output voltage shall be 28.8 (+3, -3) VDC under normal system load (CG 1510).
- c. The +28 VDC IMU STANDBY (Bus No. 3) output voltage shall be 28.8 (+3, -3) VDC under normal system load (CG 1520).
- d. The +28 VDC OPTX OPERATE (Bus No. 4) output voltage shall be 28.8 (+3, -3) VDC under normal system load (CG 1530).

6.2.4.10 Noise

- a. The +14 VDC CMC Power Supply RMS noise shall be less than 0.4 volt (CG 1021).
- b. The +4 VDC CMC Power Supply noise peak shall be less than 0.4 volt pp (CG 1031).

6.2.4.11 IMU 14/CMC Sync Phase Difference

The Phase difference between the 3.2 kc supply and CMC sync shall be $0^\circ \pm 10^\circ$ (NG 1336). Record the phase difference as indicated on the CRT.

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6.2.4.12 Miscellaneous Checks. - The following miscellaneous signals are required to supply data for system evaluation in event of failure, or for trend analysis of system performance. Record the values of the following signals displayed on the CRT.

- a. CG 4300 CMC Temperature
- b. CG 6020 PIPA Calibration Module Temperature
- c. CG 6021 IMU 800 CPS 5 per cent Temperature

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6.2.5 General Turn Off and Turn On Procedure

NOTE: This procedure shall be utilized any time after performing 6.1.3 Prepower Application Requirements, 6.2.1, Standby Power On Test, and 6.2.3. Operate Power on Test, to turn on or turn off the G&N System. Appropriate portions of this procedure will be referenced in other tests.

6.2.5.1 Turn Off Procedure

CAUTION: This procedure must be performed in the sequence specified. Failure to adhere to this sequence may require calibration of the inertial components.

6.2.5.1.1 Enter the following sequence into the K-148.

- a. VERB 41 NOUN 20, ENTER
- b. +00000 ENTER
- c. +00000 ENTER
- d. +09000 ENTER

Verify that the GIMBAL LOCK indicator on the DSKY's is illuminated.

6.2.5.1.2 Set the following switches on the G&N Indicator Control Panel to the positions designated.

- a. OPTICS MODE to MANUAL
- b. CONTROLLER MODE to DIRECT
- c. CONTROLLER SPEED to MED
- d. TELESCOPE TRUNNION to SLAVE TO SKT
- e. RETICLE BRIGHTNESS to minimum brightness position

6.2.5.1.3 Set the G/N Power - IMU switch on the LEB Lighting Control Panel to OFF and G&N IMU MN A and MN B circuit breakers on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).

6.2.5.1.4 Decrease the LIGHTS - NUMERICS controls on both the Left Hand Circuit Breaker panel and the LEB Lighting Control Panel to the minimum brightness - OFF position.

6.2.5.1.5 Set the IMU HTR MN A and MN B circuit breaker on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).

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- 6.2.5.1.6 Set the COMPUTER MN A and MN B Circuit breakers on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).
- 6.2.5.1.7 Set the G&N Power AC1-OFF-AC2 Switch on the Right Hand Circuit breaker panel to OFF and the G&N POWER AC1 and AC2 circuit breakers to OFF (breakers pulled out).
- 6.2.5.1.8 Set the G/N POWER - OPTICS switch on the LEB Lighting Control Panel to OFF and G&N OPTICS MN A and MN B breakers on the Right Hand circuit breaker panel to OFF.
- 6.2.5.1.9 Verify that the ICTC is supplying inertial components heater power to the G&N System. This will be indicated by the following on the PTC.
- a. G&N ON (PTC inhibit) light not illuminated.
 - b. IMU Temp/heater current meter indicates IMU temperature of $130 \pm 5^\circ\text{F}$.
- 6.2.5.2 Turn ON Procedure
- 6.2.5.2.1 Set or verify the following G&N Indicator Control Panel switches to the position indicated.
- a. CONDITION LAMPS to ON
 - b. OPTICS MODE to MANUAL
 - c. CONTROLLER COUPLING to DIRECT
 - d. CONTROLLER SPEED to DIRECT
 - e. TELESCOPE TRUNNION to SLAVE to SXT
 - f. RETICLE BRIGHTNESS to minimum brightness position.
- 6.2.5.2.2 Insure that interfacing system EPS and ECS are turned on and operating properly.
- CAUTION: The remaining procedure must be followed in sequence specified. Failure to adhere to this sequence may require recalibration of the inertial components.

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- 6.2.5.2.3 Energize the G&W COMPUTER MW A and MW B breakers on the Right Hand Circuit Breaker panel (breakers pushed in). If the STBY indicator on the DSKY is illuminated, press the STBY pushbutton for approximately 3 seconds until the STBY indicator extinguishes. Enter VERB 61 into K148 and press the ENTER pushbutton. Insure that the CMC +28 VDC discrete lamp on the Event Module is illuminated (CG 1523). Verify +14 and +4 VDC AGC power supply outputs on CRT display. Voltages shall be $+14 \pm 0.4V$ (CG 1020) and $+4 \pm 0.2$ (CG 1030).
- 6.2.5.2.4 Set the G&W POWER AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in). Set the G&W POWER AC1-OFF-AC2 switch to AC1.
- 6.2.5.2.4.1 Set the G&W DSKY and Display Panel brightness to the minimum acceptable level by manipulation of LIGHTS - NUMERICS control on both Left Hand circuit breaker panel and LEB lighting Control panel.
- 6.2.5.2.5 Energize the G&W IMU HTR, MW A and MW B breakers on the Right Hand Circuit Breaker panel (breakers pushed in).
- 6.2.5.2.6 Disregard all alarm indication on the CMC DSKY panels. Enter VERB 36 into K148. Press ENTER pushbutton. Press ERROR RESET pushbuttons on K-Start. All computer alarms except the Gimbal Lock Indicator on the Main Display Console (MDC) and LEB AGC DSKY shall clear. Verify registers R1, R2, and R3 on the DSKY's are cleared.
- 6.2.5.2.7 Clear the CMC erasable memory by entering the following sequence into the K-Start.
- a. VERB 57, press ENTER
 - b. 00015, press ENTER

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6.2.5.2.8 Initiate GNC self-check by entering the following sequence into the K-Start:

- a. VERB 21
- b. NOUN 27, press ENTER
- c. 77777, press ENTER

Wait 5 minutes and -

6.2.5.2.8.1 Verify that R1 does not display 01102 or 41102. If an error is detected, the following will be displayed:

VERB 05 NOUN 31
R1 = 01102 or 41102
R2 = XXXXX o (S Fail)
R3 = XXXXX o (ERcount)

6.2.5.2.8.2 Enter the following into the K-Start:

- a. VERB 21
- b. NOUN 27 ENTER
- c. 00000, ENTER

NOTE: Allow 2 hours to elapse before proceeding to 6.2.5.2.9 with the following exceptions:

- a. If the G&N System has been in the power off state for less than 5 days with the gimbals in the parked position (0°, 0°, 90°) and the system has not been moved, allow 90 seconds to elapse before proceeding.
- b. If the G&N System has been turned off for less than 15 minutes allow 90 seconds to elapse before proceeding.
- c. If the G&N System has been turned off with the gimbals in the unparked position for more than 15 minutes but less than 2 hours allow a warmup time equal to the time off to elapse before proceeding.

CAUTION: If the requirements of 6.2.5.2.10 are not met, remove IMU Operate Power immediately by setting the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

6.2.5.2.9 After the required warmup time has elapsed set the G&N IMU MN A and MN B circuit breaker on the Right Hand circuit breaker panel to ON (breaker pushed in), and the G/N POWER - IMU switch on the LEB Lighting Control panel to the ON position (toggle up).

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6.2.5.2.10 Immediately begin monitoring the following measurements.

- a. On the CRT verify that IMU Operate Power is $\pm 28.8 \pm 3$ VDC (CG 1500).
- b. On the meter modules verify that oscillations are not sustained and that a null is achieved within 10 seconds of power application on the following measurements:

CG 2112 IG 1X Resolver Output Sin
CG 2142 MG 1X Resolver Output Sin
CG 2172 OG 1X Resolver Output Sin

- c. On the CRT verify the absence of the +120 VDC PIPA Supply (CG 1040) for a period of 90 ± 10 seconds following power application. After approximately 100 seconds, the voltage shall read $+120 \pm 6$ VDC.

6.2.5.2.11 Verify that the PROGRAM ALARM lamp on the DESKY's does not light with VERB 05 MOUN 31 and R1 = 00213 displayed.

6.2.5.2.12 Enter and verify VERB 40, MOUN 20 into K148. Press the ENTER pushbutton.

6.2.5.2.13 Enter and verify VERB 41, MOUN 20 into K148. Press the ENTER pushbutton to advance the System to the Coarse Align mode. The VERB-MOUN display on the CRT shall flash and indicate 21-22.

6.2.5.2.14 Enter and verify +00000 into K148 three times, pressing the ENTER pushbutton on the K-START after each entry.

6.2.5.2.15 Set the G/M OPTICS MW A and MW B circuit breakers on the Right Hand circuit breaker panel to the ON position (breaker pushed in). Place the G/M POWER-OPTICS switch on the LEB Lighting Control Panel to the ON position (toggle up). Verify that the OPTICS +28 VDC discrete lamp on the Event Module is illuminated (CG 1533).

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- 6.2.5.2.16 Verify that the CRT indications of the signals in Table VI are not flashing.

Table VI. Secondary Power Supply Voltages

Measurement Number	Signal
1 CG 1040	+120 VDC PIPA SUPPLY
2 CG 1051	+20 VDC PIPA SUPPLY
3 CG 1052	-20 VDC PIPA SUPPLY
4 CG 1070	+4 VDC CDU SUPPLY
5 CG 1100	-28 VDC ELECTRONICS
6 CG 1020	+14 VDC CMC SUPPLY
7 CG 1030	+4 VDC CMC SUPPLY
8 CG 1201	IMU 28V 800 CPS 1 pet 0 ph
9 CG 1202	IMU 28V 800 CPS 5 pet ph A
10 CG 1203	IMU 28V 800 CPS 5 pet ph B
11 CG 1331	3.2 MC 28V SUPPLY
12 CG 1211	OPTX 28V 800 CPS 1 pet 0 ph
13 CG 1212	OPTX 800 CPS 5 pet 90 ph
14 CG 1110	2.5 VDC TM BIAS
15 CG 2300	PIPA TEMPERATURE
16 CG 2301	IRIG TEMPERATURE

- 6.2.5.2.17 Monitor the PIPA Display Scope to insure that each PIPA is reading properly.

- 6.2.5.2.18 Perform 6.2.6 G&N Operational Test.

- 6.2.6 G&N Operational Test

- 6.2.6.1 Initial Conditions

Proceed with this test if the Operate Power On Test of 6.2.3 or the Turn On Procedure of 6.2.5 has been completed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding.

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6.2.6.2 Initiation

6.2.6.2.1 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.6.2.2 Enter 00004 into K148. Press the ENTER pushbutton.

6.2.6.2.3 Verify that the PROGRAM display on the CRT indicates 07.

NOTE: During this portion of the test the G&N System is exercised through its modes. Any failures will be indicated by the PROGRAM ALARM lamp on the DSKY's lighting with VERB 05 NOUN 31 and R1= 01411 displayed.

6.2.6.2.4 After approximately 12 minutes, VERB 06, NOUN 66 will flash and the value of the gravity vector in cm/sec^2 shall be displayed in R1 and R2 on the CRT. Record these values.6.2.6.2.5 R1 contains the first five digits of the gravity vector and R2 contains the last five digits. A decimal point shall be between them. The value for the gravity vector shall be $960.00000 \pm 05.00000 \text{ cm/sec}^2$.

6.2.6.2.6 Enter VERB 33 into K148. Press the ENTER pushbutton.

6.2.6.2.7 When VERB 06 NOUN 66 flashes the value of the horizontal earth rate shall be displayed in R1 and R2 on the CRT. Record these values.

6.2.6.2.8 R1 contains the first five digits of earth rate and R2 contains the last five digits. A decimal point shall be placed between them. R1 shall always to 00000. The horizontal earth rate shall be 00000.83000 ± 0.1000 earth rate units.

6.2.6.3 Test Termination

6.2.6.3.1 Enter VERB 36 into K148. Press the ENTER pushbutton.

6.2.6.3.2 Enter VERB 41, NOUN 20 into K148. Press the ENTER pushbutton.

6.2.6.3.3 Enter +00000 into K148 three times. Press the ENTER pushbutton after each entry.

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6.2.7 Gimbal Friction Test

6.2.7.1 Proceed with this test if 6.2.5.2 or 6.2.3 has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 before proceeding with this test.

6.2.7.2 Inner Gimbal Friction Test

6.2.7.2.1 Enter the following sequence into the K-Start, pushing the ENTER pushbutton after each entry:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.7.2.2 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

- a. CG 2120 IG TORQUE MOTOR CURRENT
- b. CG 2117 IGA SERVO ERROR IN PHASE
- c. CG 2112 IG 1X RESOLVER OUTPUT SIN
- d. CG 2113 IG 1X RESOLVER OUTPUT COS
- e. CG 2220 IGA CDU FINE ERROR
- f. CG 1201 IMU 28 V 0.8KC 1 pct 0 Deg
- g. CG 2300 PIPA TEMPERATURE
- h. CG 2301 IIRIG TEMPERATURE

6.2.7.2.3 Enter the following sequence into the K-Start, pushing the ENTER pushbutton after each entry (+360 IG torquing)

- a. VERB 24 NOUN 01, ENTER
- b. 00407, ENTER
- c. 40000, ENTER
- d. 40034, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.2.4 Enter the following sequence into K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (verify VERB 33 on CRT)

6.2.7.2.5 Start analog recorders.

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- 6.2.7.2.6 Observe measurement CG 2112, IG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.
- 6.2.7.2.7 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.
- a. VERB 40, NOUN 20, press ENTER
 - b. VERB 41, NOUN 20, press ENTER
 - c. +00000, press ENTER
 - d. +00000, press ENTER
 - e. +00000, press ENTER
- 6.2.7.2.8 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 60 seconds before proceeding.
- 6.2.7.2.9 Enter the following sequence into the K-Start. Push the ENTER push button after each entry (-360° IG torquing):
- a. VERB 24 NOUN 01 ENTER
 - b. 00407, ENTER
 - c. 37777, ENTER
 - d. 37743, ENTER
- Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.
- 6.2.7.2.10 Enter the following sequence into K-Start:
- a. VERB 42, press ENTER
 - b. VERB 33, press ENTER (Verify VERB 33 on CRT).
- 6.2.7.2.11 Start analog recorders.
- 6.2.7.2.12 Observe measurement CG 2112, IG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.
- 6.2.7.2.13 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.
- a. VERB 40, NOUN 20, press ENTER
 - b. VERB 41, NOUN 20, press ENTER
 - c. +00000, press ENTER
 - d. +00000, press ENTER
 - e. +00000, press ENTER
- 6.2.7.2.14 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 60 seconds before proceeding.

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6.2.7.3 Outer Gimbal Friction Test

6.2.7.3.1 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

- a. CG 2180 CG TORQUE MOTOR CURRENT
- b. CG 2177 OGA SERVO ERROR IN PHASE
- c. CG 2172 CG 1X RESOLVER OUTPUT SIN
- d. CG 2173 CG 1X RESOLVER OUTPUT COS
- e. CG 2280 OGA CDU FINE ERROR
- f. CG 1201 IMU 28 V 0.8 KC 1 PCT 0 DEG RMS
- g. CG 2300 PIPA TEMPERATURE
- h. CG 2301 IIRIG TEMPERATURE

6.2.7.3.2 Enter the following sequence into the K-Start. Pushing the ENTER " pushbutton after each entry (+360° CG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00405, ENTER
- c. 40000, ENTER
- d. 40034, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.3.3 Enter the following sequence into K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.3.4 Start analog recorders

6.2.7.3.5 Observe measurement CG 2172, CG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.

6.2.7.3.6 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 40, NOUN 20, press ENTER
- b. VERB 41, NOUN 20, press ENTER
- c. +00000, press ENTER
- d. +00000, press ENTER
- e. +00000, press ENTER

6.2.7.3.7 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 60 seconds before proceeding.

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6.2.7.3.8 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (=360° OG torquing):

- a. VERB 24, NOUN 01, ENTER
- b. 00405, ENTER
- c. 37777, ENTER
- d. 37743, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.3.9 Enter the following sequence into K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (verify VERB 33 on CRT).

6.2.7.3.10 Start analog recorders.

6.2.7.3.11 Observe measurement OG 2172, OG 1X resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorder.

6.2.7.3.12 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 40, NOUN 20, press ENTER
- b. VERB 41, NOUN 20, press ENTER
- c. +00000, press ENTER
- d. +00000, press ENTER
- e. -06750, press ENTER

6.2.7.3.13 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = -06750, Wait 60 seconds before proceeding.

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6.2.7.4 Middle Gimbal Friction Test

6.2.7.4.1 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

- a. CG 2150 MG TORQUE MOTOR CURRENT
- b. CW 2147 MGA SERVO ERROR IN PHASE
- c. CG 2142 MG 1X RESOLVER OUTPUT SIN
- d. CG 2143 MG 1X RESOLVER OUTPUT COS
- e. CG 2250 MGA CDU FINE ERROR
- f. CG 2101 IMU 28V, 0.8 KC 1 PCT 0 DEG RMS
- g. CG 2300 PIPA TEMPERATURE
- h. CG 2301 ILJ TEMPERATURE

6.2.7.4.2 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (+135° MG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00411, ENTER
- c. 63777, ENTER
- d. 77777, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.4.3 Enter the following sequence in the K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.4.4 Start the analog recorder.

6.2.7.4.5 Observe measurement CG 2142, MG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 5 minutes), stop the recorders.

6.2.7.4.6 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 40 NOUN 01, ENTER
- b. VERB 41 NOUN 20, press ENTER
- c. +00000, press ENTER
- d. +00000, press ENTER
- e. +06750, press ENTER

6.2.7.4.8 Enter the following sequence into the K-Start. Push ENTER pushbutton after each entry (-135° MG torquing):

- a. VERB 24 NOUN 01, ENTER
- b. 00411, ENTER
- c. 14000, ENTER
- d. 00000, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

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6.2.7.4.9 Enter the following sequence in the K-Start:

- a. VERB 42, press ENTER
- b. VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.4.10 Start analog recorders.

6.2.7.4.11 Observe measurement CG 2143, MD 1X Resolver output SIN, on the analog recorder. When the steady-state condition occurs, with the reading near zero (approximately 5 minutes), stop the recorders.

6.2.7.4.12 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

- a. VERB 40 MOUN 20, press ENTER
- b. VERB 41 MOUN 20, press ENTER
- c. +00000, press ENTER
- d. +00000, press ENTER
- e. +00000, press ENTER

4.2.7.5 Examine the traces of the recorded measurements for all six phases of this test to detect any sharp discontinuities. Disregard transients of 0.5 second duration or less on the Gimbal Torque motor current traces, and those less than 0.2 second on the CDU fine error measurement traces. The Gimbal Torque motor currents shall not exceed 0.125 ampere.

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- 6.2.8 G&N Panel Brightness and Lamp Test
- 6.2.8.1 Proceed with this test if 6.2.5.2 or 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 before proceeding with this test.
- 6.2.8.2 Rotate the RETICLE BRIGHTNESS thumbwheel on the Control Indicator Panel and verify the capability to control the illumination of the following lamps:
- a. SCT reticles
 - b. SRT reticles
 - c. Telescope Panel Angle Counters
- 6.2.8.3 Turn on LIGHTS-INTEGRAL control on Left Hand Circuit Breaker panel and LEB Lighting Control Panel.
- 6.2.8.4 Adjust the brightness controls on the LEB Lighting Control Panel and Left Hand Circuit Breaker Panel from minimum brightness to maximum brightness. Verify the operation of the G&N Indicator Control Panel lamps.
- 6.2.8.4.1 Re-adjust brightness controls for minimum acceptable lighting. Turn off LIGHTS-INTEGRAL control on Left Hand Circuit Breaker panel and LEB Lighting Control Panel.
- 6.2.8.5 Push and hold the CONDITION LAMPS switch on the G&N Indicator Control Panel to TEST. Verify the illumination of the following lamps:
- a. STAR ACQ
 - b. MASTER ALARM lamp
- 6.2.8.6 Set the CONDITION LAMPS switch to ON. Lamps a and b in 6.2.8.5... shall extinguish.

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6.2.9 Semi-Automatic Moding Check

Proceed with this test if 6.2.2.2.2 or 6.2.4 has been completed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.2.2 before proceeding with this test.

6.2.9.1 Test Initiation

6.2.9.1.1 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.9.1.2 Enter 00010 into K148. Press the ENTER pushbutton.

6.2.9.1.3 Observe VERB 33 NOUN 01 flashes on the CRT and the PROGRAM display indicates 07.

6.2.9.2 Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

- a. VERB 33 NOUN 02 flashing
- b. R1 = +00000 \pm 00003
- c. R2 = +00000 \pm 00003
- d. R3 = +00000 \pm 00003
- e. IO angle = 000 \pm 1 deg.
- f. MO angle = 000 \pm 1 deg.
- g. OG angle = 000 \pm 1 deg.

6.2.9.3 Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

- a. VERB 33 NOUN 03 flashing
- b. R1 = +04500 \pm 00003
- c. R2 = +04500 \pm 00003
- d. R3 = +04500 \pm 00003
- e. IO angle = 045 \pm 1 deg.
- f. MO angle = 045 \pm 1 deg.
- g. OG angle = 045 \pm 1 deg.

6.2.9.4 Press the ENTER pushbutton. After approximately 100 seconds the following data shall be displayed on the CRT.

- a. VERB 05 NOUN 30 flashing
- b. R1 = 00000 \pm 00003
- c. R2 = 00000 \pm 00003
- d. R3 = 00000 \pm 00003

NOTE: Negative numbers will be displayed in octal complement form, i.e., -00001 = 77776.

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6.2.9.5 Enter VERB 33 into KL48. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 33 MOUN 05 flashing
- b. R1 = +07100 + 00003
- c. R2 = +07100 + 00003
- d. R3 = +07100 + 00003
- e. IG angle = 071 ± 1 deg.
- f. MG angle = 071 ± 1 deg.
- g. OG angle = 071 ± 1 deg.

6.2.9.6 The GIMBAL LOCK lamps on the DSKY's shall light.

6.2.9.6 Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 33 MOUN 06 flashing
- b. R1 = +09000 + 00003
- c. R2 = +09000 + 00003
- d. R3 = +09000 + 00003
- e. IG angle = 090 ± 1 deg.
- f. MG angle = 090 ± 1 deg.
- g. OG angle = 090 ± 1 deg.

6.2.9.7 Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 33 MOUN 07
- b. R1 = +13500 + 00003
- c. R2 = +13500 + 00003
- d. R3 = +13500 + 00003
- e. IG angle = 135 ± 1 deg.
- f. MG angle = 135 ± 1 deg.
- g. OG angle = 135 ± 1 deg.

6.2.9.8 Press the ENTER pushbutton. After approximately 20 seconds VERB 33 MOUN 10 shall flash. The GIMBAL LOCK lamp shall extinguish on the DSKY's.

6.2.9.9 Press the ENTER pushbutton. After approximately 100 seconds the following data shall be displayed on the CRT.

- a. VERB 05 MOUN 30 flashing
- b. R1 = 00000 + 00003
- c. R2 = 00000 + 00003
- d. R3 = 00000 + 00003

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6.2.9.10 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 33 NOUN 12 flashing
- b. R1 = $+22500 + 00003$
- c. R2 = $+22500 + 00003$
- d. R3 = $+22500 + 00003$
- e. IO angle = $225 + 1$ deg.
- f. MO angle = $225 + 1$ deg.
- g. OG angle = $225 + 1$ deg.

The GIMBAL LOCK lamp on the DSKY's shall light.

6.2.9.11 Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 33 NOUN 13 flashing
- b. R1 = $+22500 + 00003$
- c. R2 = $+22500 + 00003$
- d. R3 = $+31500 + 00003$
- e. IO angle = $225 + 1$ deg.
- f. MO angle = $225 + 1$ deg.
- g. NO angle = $315 + 1$ deg.

The GIMBAL LOCK lamp on the DSKY shall extinguish.

6.2.9.12 Press the ENTER pushbutton. After approximately 100 seconds the following data shall be displayed on the CRT.

- a. VERB 05 NOUN 30 flashing
- b. R1 = 77766 to 77775
- c. R2 = 77766 to 77775
- d. R3 = 77766 to 77775

6.2.9.13 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 33 NOUN 15 flashing
- b. R1 = $+31500 + 00003$
- c. R2 = $+31500 + 00003$
- d. R3 = $+31500 + 00003$
- e. IO angle = $315 + 1$ deg.
- f. MO angle = $315 + 1$ deg.
- g. OG angle = $315 + 1$ deg.

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6.2.9.14 Press the ENTER pushbutton. After approximately 100 seconds the following data shall be displayed on the CRT.

- a. VERB 05 NOUN 30 flashing
- b. R1 = 00000 ± 00003
- c. R2 = 00000 ± 00003
- d. R3 = 00000 ± 00003

6.2.9.15 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

- a. VERB 33 NOUN 17 flashing
- b. R1 = +31500 ± 00003
- c. R2 = +31500 ± 00003
- d. R3 = +28900 ± 00003
- e. IG angle = 315 ± 1 deg.
- f. OG angle = 315 ± 1 deg.
- g. MG angle = 289 ± 1 deg.

The GIMBAL LOCK lamp on the DESKY's shall light.

6.2.9.16 Press the ENTER pushbutton. After approximately 20 seconds the following data will be displayed on the CRT.

- a. VERB 33 NOUN 20 flashing
- b. R1 = +00000 ± 00003
- c. R2 = +00000 ± 00003
- d. R3 = +00000 ± 00003
- e. IG angle = 000 ± 1 deg.
- f. MG angle = 000 ± 1 deg.
- g. OG angle = 000 ± 1 deg.

The GIMBAL LOCK lamp on the DESKY's shall extinguish.

6.2.9.17 Press the ENTER pushbutton. After approximately 15 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 66 flashing
- b. R1 = 000xx
- c. R2 = xxxxx

The GIMBAL LOCK lamp on the DESKY's shall light.

Record R1 and R2 as the Middle Gimbal CDU drive rate.

MG rate = $\frac{R1}{R2}$ °/sec. The Middle Gimbal CDU drive rate shall be 14 ± 2°/sec.

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6.2.9.18

Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 66 flashing
- b. R1 = 000xx
- c. R2 = xxxxx

The GIMBAL LOCK lamp on the DRY's shall extinguish.

Record R1 and R2 as the Inner Gimbal CDU drive rate.

IG rate = $\frac{R1}{14} \cdot \frac{R2}{2^9}$ /sec. The Inner Gimbal CDU drive rate shall be 14 ± 2^9 /sec.

6.2.9.19

Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 66 flashing
- b. R1 = 000xx
- c. R2 = xxxxx

Record R1 and R2 as the Outer Gimbal CDU drive rate.

OG rate = $\frac{R1}{14} \cdot \frac{R2}{2^9}$ /sec. The Outer Gimbal CDU drive rate shall be 14 ± 2^9 /sec.

6.2.9.20

Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds VERB 21 NOUN 22 shall flash on the CRT. Enter +00100 into K148 three times. Press the ENTER pushbutton after each entry. After approximately 100 seconds VERB 01 NOUN 10 flashing shall be displayed on the CRT. Press the ENTER pushbutton.

Enter 00030 into K148. Press the ENTER pushbutton. Verify R1 = 33xxx.

The ISS WARNING Lamp on the Indicator Control Panel shall light. The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be ON.

6.2.9.21

Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds VERB 21 NOUN 22 shall flash on the CRT. Enter +03375 into K148 three times. Press the ENTER pushbutton after each entry. After approximately 100 seconds VERB 01 NOUN 10 flashing shall be displayed on the CRT. Press the ENTER pushbutton.

Enter 00030 into K148. Press the ENTER pushbutton. Verify R1 = 33xxx.

The ISS WARNING lamp on the Indicator Control Panel shall light. The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be ON.

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6.2.9.22 Enter VERB 33 into K148. Press the ENTER pushbutton. VERB 33 NOUN 55 shall flash on the CRT. The ISS WARNING lamp on the Control Indicator Panel shall extinguish. The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be OFF.

6.2.9.23 Set the OPTICS MODE switch on the Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to CMC.

6.2.9.24 Press the ENTER pushbutton. After approximately 25 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 66 flashing
- b. R1 = 0000x
- c. R2 = xxxxx

Record R1 and R2 as the Shaft Optics CDU drive rate.
Shaft rate = $\frac{R1}{R2}$. The Shaft Optics CDU drive rate shall be 7.32 ± 1.00 /sec.

6.2.9.25 Enter VERB 33 into K148. Press the ENTER pushbutton. In about 15 seconds the following data shall be displayed on the CRT.

- a. VERB 06 NOUN 66
- b. R1 = 0000x
- c. R2 = xxxxx

Record R1 and R2 as the Trunnion Optics CDU drive rate. Trunnion rate = $\frac{R1}{R2}$. The Trunnion Optics CDU drive rate shall be 1.83 ± 0.50 /sec.

6.2.9.26 Terminate the Semi-Automatic Moding Check by entering VERB 34 into K148. Press the ENTER pushbutton.

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6.2.10 Zero Optics Test

6.2.10.1 Proceed with this test if 6.2.4 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.2.2 Turn On procedure before proceeding.

6.2.10.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.10.3 Insure that the following switches on the G&W Indicator Control Panel are set as follows:

- a. TELESCOPE TRUNNION to SLAVE TO SXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to HI

6.2.10.4 Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K148. Press the ENTER pushbutton.

6.2.10.5 Set the OPTICS MODE switch on the G&W Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following on R1 and R2 of the CRT.

- a. R1 = $+000.00 \pm 000.03$ (Shaft Angle)
- b. R2 = $+00.000 \pm 00.006$ (Trunnion LOS Angle)

Return the OPTICS MODE switch to MAN.

6.2.10.6 Set up the Analog Recorder to monitor the following measurements. Use a chart speed of 10 mm/sec.

- a. CG 3140 SXT Shaft Tach Output
- b. CG 3145 SXT Shaft Motor Control Winding
- c. CG 3150 SXT Trunnion Tach Output
- d. CG 3155 SXT Trunnion Motor Control Winding
- e. CG 3160 SCT Shaft Tach Output
- f. CG 3170 SCT Trunnion Tach Output

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- 6.2.10.7 Push the Optics Hand Controller to the right, driving the SXT Shaft until R1 on the CRT indicates +180.00. Push the Optics Hand Controller up, driving the SXT Trunnion until R2 on the CRT indicates +75.000.
- 6.2.10.8 Start the Analog Recorders and set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.
- 6.2.10.9 Monitor the Analog Recorders until all signals return to null. Stop the Analog Recorders. The elapsed time between the initial and final SXT Tach output null shall be less than 15 seconds.
- 6.2.10.10 Record R1 and R2 on the CRT. The data displayed shall be as follows:
- a. $R1 = 000.00 \pm 000.03$
 - b. $R2 = 00.000 \pm 00.006$
- 6.2.10.11 Record the Telescope Panel Angle Counter indications. The Shaft Angle shall be 0.0 ± 0.1 degrees. The Trunnion Angle shall be 0.0 ± 0.2 degrees.
- 6.2.10.12 Set the OPTICS MODE switch on the G&N Indicator Control Panel to MAN.

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6.2.11 OPTICS Coordinate Transformation Control Test

6.2.11.1 Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding.

6.2.11.2 Enter the following into the K-Start. Press the ENTER pushbutton after each entry:

- a. VERS 41 HOUR 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.11.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the position indicated.

- a. TELESCOPE TRUNNION to SLAVE TO SET
- b. CONTROLLER COUPLING to SUBJECT
- c. CONTROLLER SPEED to HI

6.2.11.4 Enter the following into the K-Start to monitor the OPTICS CDU's:
VERS 16 HOUR 55, press ENTER

6.2.11.5 Set the OPTICS MODE switch on the G&N Panel to ZERO. Wait 15 seconds. Insure that the Optics were properly by observing that R1 and R2 of the CRT indicate as follows:

- a. R1 = $+000.00 \pm 000.03$ (Shaft Angle)
- b. R2 = $+00.000 \pm 000.06$ (Trunnion LOS Angle)

Return the OPTICS MODE switch to MAN.

6.2.11.6 Set up the analog recorders to monitor the following measurements:

- a. CG 3160 SCT Shaft Tachometer Output
- b. CG 3170 SCT Trunnion Tachometer Output

6.2.11.7 Using the OPTICS CONTROL STICK, drive the Optics until R1 = 225.00 and R2 = 10.000 on the CRT and the DSKY's.

6.2.11.8 Set the CONTROLLER COUPLING switch on the G&N Panel to RELV and the controller speed switch to MED.

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- 6.2.11.9 Position the movable optics target such that it is centered on the SCT retical pattern, then start the analog recorders at a chart speed of 10 mm/second.
- 6.2.11.10 Quickly displace the OPTICS CONTROL STICK ± 10 degrees in the upper right hand quadrant while sighting on the optics target through the SCT eyepiece. The target shall appear to move in the upper right field of view of the SCT at ± 10 deg. Release the control stick when the target leaves the SCT upper right field of view, and immediately record the shaft angle as displayed on RI of the CRT and DEKY's. The recorded shaft angle shall be $\pm 225 \pm 10.00$ degrees.
- 6.2.11.11 Stop the analog recorder and measure the elapsed time between the initial and the final signal null conditions for the two measurements. The elapsed time shall be 24 ± 6 seconds.
- 6.2.11.12 Set the CONTROLLER COUPLING switch on the G&W Panel to DIRECT and drive the Optics with the OPTICS CONTROL STICK until the shaft and trunnion angles as indicated on the SCT TPAC's are approximately zero, then repeat step 6.2.11.5.

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6.2.12 Optics Positional Accuracy Test

- 6.2.12.1** Proceed with this test if 6.2.3, Operate Power On Test, or 6.2.5.2, Turn On Procedure, has been performed, and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2, Turn On Procedure, before proceeding.

NOTE: This test requires the use of G&N Installation Qualification Fixture A23-071 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT SLOS before proceeding. Determine the including angle between the Autosets and insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.

- 6.2.12.2** Enter the following sequence into the K-Start. Depress the **ENTER** pushbutton after each entry.

- a. **VERB 40 NOUN 20, ENTER**
- b. **+00000, ENTER**
- c. **+00000, ENTER**
- d. **+00000, ENTER**

- 6.2.12.3** Insure that **OPTICS** power is applied and the Optics controls are set as follows:

- a. **OPTICS MODE** to **MANUAL**
- b. **CONTROLLER SPEED** to **LO**
- c. **CONTROLLER COUPLING** to **DIRECT**
- d. **TELESCOPE TRUNNION** to **SLAVE TO SXT**

- 6.2.12.4** Set the **OPTICS MODE** switch to **ZERO**. After 30 seconds return the switch to **MANUAL**.

6.2.12.5 Resolution Checks

- 6.2.12.5.1** Sight through the **SXT** eyepiece. Using the **OPTICS CONTROL STICK**, adjust the **SXT** to get the best reflected view of the 5-inch autocollimator reticle engravings at the center of the field of view.

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- 6.2.12.5.2 Note that the autocollimator reticle contains a series of lines of different thickness and width. Each set of lines is marked with a number (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines. The SCT resolution shall be at least 10 arc-seconds at the center field of view.
- 6.2.12.5.3 Repeat 6.2.12.5.1 and 6.2.12.5.2 using the SCT and a 1x eyepiece and the SCT resolution chart. The SCT shall have a resolution of at least 3 arc-minutes at the center of the field of view.
- 6.2.12.6 Slave Telescope Mode Checks
- 6.2.12.6.1 Using the OPTICS CONTROL STICK, drive the optics to approximately zero Shaft and Trunnion Angle. Set the OPTICS MODE switch to ZERO. After 30 seconds return the switch to MANUAL.
- 6.2.12.6.2 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton. Record R1 = xxx.xx as shaft CDU angle. Record R2 = xx.xxx as trunnion CDU angle. Record the SCT Shaft and Trunnion Angles as indicated on the TPAC. The Trunnion angle readings shall differ by 0.22° or less. The Shaft angle readings shall differ by 0.11° or less.
- 6.2.12.6.3 Using the CONTROL STICK, drive the Shaft and Trunnion Angles to 035.00° and 35.000° respectively. Record the SCT Shaft and Trunnion Angles from the TPAC. The Trunnion Angle readings shall differ by 0.22° or less. The Shaft Angle readings shall differ by 0.11° or less.
- 6.2.12.6.4 Set the OPTICS MODE switch to ZERO. After 30 seconds return switch to MANUAL.
- 6.2.12.6.5 Attach the Retroreflecting Prism, Model No. A23-200 between the SXT and SCT.
- NOTE: If needed to reduce external light, place a photographers head over the optics window and the Retroreflecting Prism.
- 6.2.12.6.6 Remove the Mirror Assembly cover plate from the SXT eyepiece and attach or hold the Portable Light Assembly Model No. over the SXT eyepiece. Turn on the light in the Mirror Assembly mounting hole.

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- 6.2.12.6.7 Set the TELESCOPE TRUNNION switch to 0°.
- 6.2.12.6.8 Sight through the SCT eyepiece. The SXT reticle center shall appear within a circle bounded by the SCT reticle 0° discontinuity.
- 6.2.12.6.9 Using the CONTROL STICK, drive the TRUNNION Angle to 25.000 degrees.
- 6.2.12.6.10 Set the TELESCOPE TRUNNION switch to OFFSET 25°. Wait 30 seconds.
- 6.2.12.6.11 Sight through the SCT eyepiece. The SXT reticle center shall appear within a circle bounded by the SCT reticle 0° discontinuity.
- 6.2.12.6.12 Repeat 6.2.12.6.4. Sight through the SCT eyepiece. The SXT reticle center shall appear within a circle bounded by the SCT reticle 25° discontinuity.
- 6.2.12.6.13 Set the TELESCOPE TRUNNION switch to SLAVE TO SXT. Repeat 6.2.12.6.4. Record the SXT SHAFT & TRUNNION CDU angles (R1 and R2).
- 6.2.12.6.14 Remove the OPTICS OPERATE POWER by setting the G/N POWER-OPTICS switch on Panel 99 to OFF.
- 6.2.12.6.15 Sight through the SCT and adjust the SCT Shaft and Trunnion Angles using the SCT adjustment tools, so that the SXT reticle image coincides with the SCT reticle. Record the SCT Shaft and Trunnion Angles from the TPAC. The difference between these angles and those recorded in 6.2.12.6.13 shall be 0.2° or less.
- 6.2.12.6.16 Reapply OPTICS OPERATE POWER by setting the G/N POWER-OPTICS switch on Panel 99 to ON.
- 6.2.12.6.17 Remove the hood (if used) and Retrereflecting Prism. Do not remove the Portable Lamp Assembly.
- 6.2.12.6.18 Check the Trunnion

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- 6.2.12.8 Shaft and Trunnion Positional Accuracy Checks
- 6.2.12.8.1 Set the OPTICS MODE switch to ZERO. After 30 seconds, return the selector to MANUAL.
- 6.2.12.8.2 Sight through the SXT. Using the control stick align the SXT SLOS with optical target No. 1 on the G&N Installation Fixture Model No. A23-071.
- 6.2.12.8.3 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton. Record the value of R1 and R2 displayed on the CRT. Record the Shaft and Trunnion Angles from the TPAC.
- 6.2.12.8.4 Sight through the SXT. Using the control stick align the SXT SLOS with Optical Target No. 2 on A23-071.
- 6.2.12.8.5 Record the value in R1 and R2 on the CRT. Record the Shaft and Trunnion Angles from the TPAC.
- 6.2.12.8.6 Set the OPTICS MODE switch to ZERO. After 30 seconds set the switch to CMC.
- 6.2.12.8.7 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.8 Enter the value recorded from R1 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.9 Enter the value recorded from R2 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.10 Sight through the SXT. The SLOS should be centered on Optical Target No. 1 on A23-071. Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.3 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.11 Enter VERB 41 NOUN 55 into the K-START. Press the ENTER pushbutton.
- 6.2.12.8.12 Enter the value recorded from R1 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.
- 6.2.12.8.13 Enter the value recorded from R2 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.

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- 6.2.12.8.14 Sight through the SXT. The SLOS should be centered on Optical Target No. 2 on A23-071. Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.5 shall be less than 0.25 degrees. Record the difference.
- 6.2.12.8.15 Set the OPTICS MODE switch to ZERO. After 30 seconds return the switch to MANUAL.
- 6.2.12.8.16 Enter VERB 41 NOUN 20 into the K-START. Press the ENTER pushbutton. Enter +00000 into the K-START 3 times. Press the ENTER pushbutton after each entry.

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6.2.13 Optics Slew Rate Test

6.2.13.1 Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On procedure, before proceeding.

6.2.13.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.

- a. VERB 41 NOUN 20, ENTER
- b. + 00000, ENTER
- c. + 00000, ENTER
- d. + 00000, ENTER

6.2.13.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the positions indicated.

- a. TELESCOPE TRUNNION to SLAVE to SIXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to HI

6.2.13.4 Monitor the OCDU's by entering VERB 16 NOUN 55 into K148. Press the ENTER pushbutton.

6.2.13.5 Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following data displayed in R1 and R2 on the DSKY.

- a. R1 = + 000.00 + 000.03 (Shaft Angle)
- b. R2 = + 00.000 + 00.006 (Trunnion LOS Angle)

Set the OPTICS MODE switch on the G&N Indicator Panel to MAN.

NOTE: Read & understand step 6.2.13.6 before proceeding. Do not hold Control Stick at upper limit more than 10 seconds.

Trunnion Slew Rate - HI Speed

6.2.13.6 Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 5 seconds after the first mark, again press the MARK pushbutton and record the new display in R2 and R3. The data displayed is in the following form:

- a. R2 = + XX.XXX (Trunnion LOS angle in deg.)
- b. R3 = + XXX.XX (Time in seconds)

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6.2.13.7 Perform the following calculations:

- Difference between R2 displays = $\frac{\Delta \text{ trun. angle}}{\Delta \text{ time}}$
- Difference between R3 displays = $\frac{\Delta \text{ trun. angle}}{\Delta \text{ time}}$
- $\frac{\Delta \text{ trun. angle}}{\Delta \text{ time}} = \text{deg/sec}$

T

The Trunnion slew rate shall be $9.0 \pm 1.8 \text{ deg/sec}$.

Shaft Slew Rate - HI Speed

6.2.13.8 Using the Optics Control Stick, drive the Trunnion LOS Angle back to approximately zero degrees as indicated on the TPAC. Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read and understand step 6.2.13.9 before proceeding. Do not hold for more than 10 seconds.

6.2.13.9 Push and hold the Optics Control stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 5 seconds after the first mark, again press the MARK pushbutton and record the new display in R1 and R3. The data displayed is in the following form.

R1 = + XXX.XX (Shaft angle in deg.)
R3 = + XXX.XX (Time in seconds)

6.2.13.10 Perform the following calculations

- Difference between R1 displays = $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}}$
- Difference between R3 displays = $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}}$
- $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \text{deg/sec}$

The Shaft Slew Rate shall be $17.6 \pm 3.5 \text{ deg/sec}$.

Trunnion Slew Rate - MED Speed

6.2.13.11 Using the Optics Control Stick, drive the shaft angle back to approximately zero degrees as indicated on the TPAC. Set the OPTICS MODE switch to zero. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to MED.

NOTE: Read & understand 6.2.13.12 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

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6.2.13.12 Push and hold the Optics Control stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 10 seconds after the first mark, again press the MARK pushbutton and record the new display in R2 & R3. The data displayed is in the following form:

- a. R2 = XX.XXX (Trunnion LOS Angle in degrees)
- b. R3 = XXX.XX (Time in seconds)

6.2.13.13 Perform the following calculations:

- a. a. Difference between R2 displays = ---.--- (Δ Trunnion Angle)
- b. Difference between R3 displays = ---.--- (Δ Time)

c. The Δ Trunnion angle = --- deg./sec

Δ Time

The Trunnion slew rate shall be 0.90 ± 0.18 deg/sec.

Shaft Slew Rate - MED Speed

6.2.13.14 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read & understand 6.2.13.15 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.15 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 10 seconds after the first mark, again press the MARK pushbutton and record the new display in R1 and R3. The data displayed is in the following form:

- a. R1 = + XXX.XX (Shaft Angle in degrees)
- b. R3 = \pm XXX.XX (Time in seconds)

6.2.13.16 Perform the following calculations

- a. Difference between R1 displays = ---.--- (Δ Shaft Angle)
- b. Difference between R3 displays = ---.--- (Δ Time)

c. Δ Shaft Angle = --- deg/sec

Δ Time

The Shaft Slew Rate shall be 1.80 ± 0.36 deg/sec.

Trunnion Slew Rate - LO Speed

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6.2.13.17 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to LO.

NOTE: Read and understand 6.2.13.18 before proceeding. Do not hold control stick at upper limit for more than 30 seconds.

6.2.13.18 Push and hold the Optics Control stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 10 seconds after the first mark, again press the MARK pushbutton and record the new display in R2 and R3. The data displayed is in the following form:

- a. R2 = XX.XXX (Trunnion LOS Angle in degrees)
- b. R3 = XXX.XX (Time in seconds)

6.2.13.19 Perform the following calculations:

- a. Difference between R2 displays = XX.XXX (Δ Trunnion Angle)
- b. Difference between R3 displays = XXX.XX (Δ Time)
- c.
$$\frac{\Delta \text{ Trunnion Angle}}{\Delta \text{ Time}} = \text{--- deg/sec}$$

The Trunnion Slew Rate shall be 0.10 ± 0.02 deg/sec.

Shaft Slew Rate - LO Speed

6.2.13.20 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read and understand 6.2.13.21 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.21 Push and hold the Optics Control stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 10 seconds after the first mark, again press the MARK pushbutton and record the new display in R1 and R3. The data displayed is in the following form:

- a. R1 = XXX.XX (Shaft Angle in degrees)
- b. R3 = XXX.XX (Time in seconds)

6.2.13.22 Perform the following calculations:

- a. Difference between R1 displays = --- (Δ Shaft Angle)
- b. Difference between R3 displays = --- (Δ Time)
- c.
$$\frac{\Delta \text{ Shaft Angle}}{\Delta \text{ Time}} = \text{--- deg/sec}$$

The Shaft Slew Rate shall be 0.20 ± 0.04 deg/sec.

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6.2.14 Stabilization Loop Step Response Test

6.2.14.1 Proceed with this test if the Operate Power On Test of 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding. Insure that the Carry-on Command Stimuli Unit, Model No. C14-200, is installed and connected.

6.2.14.2 Enter VERB 36 into K148. Press the ENTER pushbutton, then the ERROR RESET pushbutton.

6.2.14.3 Inner Gimbal Response Test

6.2.14.4.1 Enter code 2032000000 in C-START Module 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2117 IGA SERVO ERROR on 4A1-A3-CH1.

6.2.14.4.2 Enter VERB 41 NOUN 20 into K148. Press ENTER pushbutton.

6.2.14.4.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.

6.2.14.4.4 Enter VERB 42 into K148. Press ENTER.

6.2.14.4.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.

6.2.14.4.6 Enter 1000 into 4A2-A6-R155. The top part of the switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.

6.2.14.4.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the IG stabilization loop.

CAUTION: If the transient caused by the step input does not die out within 15 seconds, remove the IDU OPERATE power by setting the O/M POWER IDU switch on the LEB Lighting Control Panel to OFF.

6.2.14.4.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.

6.2.14.4.9 Enter 0000 into 4A2-A6-R155; the top part of switch should be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the IG Stabilization Loop. The bottom part of switch shall be extinguished.

6.2.14.4.10 After the transient has died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step (initial disturbance) and the peak of the first overshoot. In addition, record the total number of overshoots.

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- 6.2.14.4.10.1 The inner gimbal stabilization loop response time shall be less than 0.2 seconds.
- 6.2.14.4.10.2 The maximum number of overshoots on the IGA Servo Error signals shall be two.
- 6.2.14.5 Middle Gimbal Response Test
- 6.2.14.5.1 Enter code 202800000 into C-START MODULE 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2147 MGA SERVO ERROR on 4A1-A3-CH1.
- 6.2.14.5.2 Enter VERB 41 NOUN 20 into K148. Press ENTER.
- 6.2.14.5.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.
- 6.2.14.5.4 Enter VERB 42 into K148. Press ENTER.
- 6.2.14.5.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.
- 6.2.14.5.6 Enter 0100 into 4A2-A6-R155. The top part of switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.
- 6.2.14.5.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the MG Stabilization Loop.
- CAUTION: If the transient caused by the step input does not die within 15 seconds, remove the DMU OPERATE power by setting the G/N POWER DMU switch on the LEB Lighting Control Panel to OFF.
- 6.2.14.5.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.
- 6.2.14.5.9 Enter 0000 into 4A2-A6-R155. The top part of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press XEQ/SEAL pushbutton to remove the step input to the MG stabilization loop.
- 6.2.14.5.10 After the transients have died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step (initial disturbance) and the peak of the first overshoot. In addition, record the total number of overshoots.
- 6.2.14.5.10.1 The middle gimbal stabilization loop response time shall be less than 0.2 seconds.
- 6.2.14.5.10.2 The maximum number of overshoots on the MGA Servo Error signals shall be two.

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6.2.14.6 Outer Gimbal Response Test

6.2.14.6.1 Enter code 2026000000 in C-START Module 4A1-A5-C156. Press XEQ/SEAL Pushbutton to call up OG 2177 OGA SERVO ERROR on 4A1-A3-CH1.

6.2.14.6.2 Enter VERB 41 NOUN 20 into K148. Press ENTER.

6.2.14.6.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.

6.2.14.6.4 Enter VERB 42 into K148. Press ENTER pushbutton.

6.2.14.6.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.

6.2.14.6.6 Enter 0010 into 4A2-A6-R155. The top half of the switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.

6.2.14.6.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the OG Stabilization Loops.

NOTE: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.

6.2.14.6.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.

6.2.14.6.9 Enter 0000 into 4A2-A6-R155. The top half of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the OG Stabilization Loop.

6.2.14.6.10 After the transients have died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step (initial disturbance) and the peak of the first overshoot. In addition, record the total number of overshoots.

6.2.14.6.10.1 The outer gimbal stabilization loop response time shall be less than 0.2 seconds.

6.2.14.6.10.2 The maximum number of overshoots on the OGA Serve Error Signals shall be two.

6.2.14.7 Enter VERB 40 NOUN 20 into K148. Press the ENTER pushbutton.

6.2.14.7.1 Enter VERB 41 NOUN 20 into K148. Press the ENTER pushbutton.

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6.2.14.7.2 Enter +00000 into K148. Press the ENTER pushbutton.

6.2.14.7.3 Enter +00000 into K148. Press the ENTER pushbutton.

6.2.14.7.4 Enter +00000 into K148. Press the ENTER pushbutton.

6.2.15 IRIG Scale Factor Test

6.2.15.1 Proceed with this test if the Operate Power On Test of 6.2.3 or the Turn On Procedure of 6.2.5.2 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 before proceeding.

6.2.15.2 Verify that the IMU OPERATE power has been applied for a minimum of 1 hour, and that at least 1 hour has elapsed since running of the Gimbal Friction Test, 6.2.7.

6.2.15.3 Set up the Analog Recorders to monitor the following signals:

- a. CG 2117 IG SERVO ERROR
- b. CG 2147 MG SERVO ERROR
- c. CG 2177 OG SERVO ERROR
- d. CG 2120 IG TM CURRENT
- e. CG 2150 MG TM CURRENT
- f. CG 2180 OG TM CURRENT

6.2.15.3.1 Start the analog recorder chart drive using a chart speed of 1 mm/sec. The recorder shall run for the duration of 6.2.15.

6.2.15.4 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.15.5 Enter 00005 into K148. Press the ENTER pushbutton.

6.2.15.6 VERB 06 HOUN 61 shall flash on CRT and the following displayed in R1 and R2:

R1 = +XXXXX (some Nav. Base azimuth)
R2 = -XXXXX (some test site latitude; see Table I)

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6.2.15.7 If the values displayed in R1 and R2 are correct, proceed with test, if not perform the following sequence:

- a. To correct R1, on the K-start enter VERB 21, press ENTER pushbutton, ~~xxxx.xx~~, press ENTER (~~xxxx.xx~~ is correct nav. base azimuth).
- b. To correct R2, on the K-start enter VERB 22, press ENTER pushbutton, ~~xx.xxx~~, press ENTER (obtain correct site latitude from Table I).

Table I

Site	Latitude
NAA	+33.921
NBC	+29.556
MILA	+28.516

6.2.15.8 Verify the correct displays on CRT R1 and R2, then on the K-start enter VERB 33 and press ENTER pushbutton.

6.2.15.9 VERB 21 MOUN 30 shall flash on the CRT, requesting a load of the test number.

Enter the desired test number from Table I and press the ENTER pushbutton.

Table I. Test Numbers and Positions for IRIG Tests

Test Number	Gyro Being Tested and Direction of Torque
+00001	+X
+00002	+Y
+00003	+Z
-00001	-X
-00002	-Y
-00003	-Z

NOTE: If all gyros are being tested, the test must be repeated once for each Test Number in Table I in the sequence listed. If only one gyro is being tested, the test need only be repeated for the two applicable Test Numbers.

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- 6.2.15.10 After 160 seconds VERB 06 NOUN 66 shall flash on the CRT. Record the value displayed in register R1 for the appropriate Test Number in Table 2. The data displayed in the Scale Factor error in parts per million. The recorded Scale Factor error shall not exceed ± 1750 ppm.

Table 2. Display of Test Parameters

Test Number	Symbol	Display in R1
-00001	E+X	XXXXXX
+00001	E-X	XXXXXX
-00002	E+Y	XXXXXX
+00002	E-Y	XXXXXX
-00003	E+Z	XXXXXX
+00003	E-Z	XXXXXX

- 6.2.15.11 Enter VERB 33 into K148. Press the ENTER pushbutton.
- 6.2.15.12 Repeat 6.2.15.8 through 6.2.15.10 until all Test Numbers in Table I have been utilized.
- 6.2.15.13 Enter VERB 34 into K148. Press the ENTER pushbutton.
- 6.2.15.13.1 After completion of all test numbers, stop the analog recorders.
- 6.2.15.14 Enter VERB 40 NOUN 20 in K148. Press the ENTER pushbutton.
- 6.2.15.14.1 Enter VERB 41 NOUN 20 into K148. Press the ENTER pushbutton.
- 6.2.15.14.2 Enter +00000 into K148 three times, pressing the ENTER pushbutton after each entry.
- 6.2.16 IMU Performance Test
- 6.2.16.1 Proceed with this test if the Operate Power On Test of 6.2.3 or the Turn On Procedure of 6.2.5.2 has been completed and system operation has not been interrupted. If the system operation has been interrupted, perform Turn On Procedure of 6.2.5.2 before proceeding with this test.
- 6.2.16.2 Enter VERB 01 NOUN 10 into K148. Press the ENTER pushbutton. Record R1 = AAAAA and the time of day.
- 6.2.16.3 Enter VERB 21 NOUN 02 into K148. Press the ENTER pushbutton. Enter 01300 into K148. Press ENTER. Enter AAAAA into K148. Press ENTER.
- 6.2.16.4 Enter VERB 06 NOUN 02 into K148. Press ENTER. Enter 01300 into K148. Press ENTER. Record R1 = BBBB.

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6.2.16.5 Perform the following calculations:

- a. $R1 \frac{(BBBBB) \times 5.12}{3600} = CCCC.C$ (hrs. in high order scaler channel 3)
- b. $23.3 - CCC.C = DDDDD$ Hrs.
- c. Add DDDDD to time of day recorded in step 1.

Do Not enter any of the PIPA scale factor tests within -0.2 hours of the time of day calculated in step 6.2.16.5c. This is the time at which the high order scaler, channel 3, will overflow. If a PIPA scale factor test is being performed at this time, unacceptable test results will occur.

6.2.16.6 Verify that the IMU Operate Power has been applied for at least one hour

6.2.16.7 Test Initiation.

6.2.16.7.1 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.16.7.2 Enter 00001 into K148. Press the ENTER pushbutton.

6.2.16.7.3 VERB 06 NOUN 66 shall appear flashing on CRT and will contain the following information:

R1 = XXX.XX (Some NB Azimuth)
R2 = XX.XXX (Some Test Site Latitude)

Insure that R1 = Correct NB Azimuth and R2 = Present Test Site Latitude from Table XX.

6.2.16.7.4 If R1 does not contain the correct NB Azimuth, enter the following sequence into K148.

- a. VERB 21, ENTER
b. +XXX.XX, ENTER (where +XXXXX is the NB Azimuth)

6.2.16.7.5 If R2 does not contain present Test Site Latitude enter the following sequence into K148:

- a. VERB 22, ENTER
b. Proper Data from Table XX, ENTER

Table XX

Location	Latitude
NAA	+33.921
MSC	+29.556
MILA	+28.516

6.2.16.7.6 Enter VERB 33 into K148. Press ENTER pushbutton.

6.2.16.7.7 VERB 06 NOUN 66 shall appear flashing on CRT. Verify that the following values appear on CRT.

R1 = +00900 R3 = +00001
R2 = +00000

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- 6.2.16.7.8 If the contents of R1 on the CRT are not +00900, enter the following sequence into K148.
- VERB 21, ENTER
 - +00900, ENTER
- 6.2.16.7.9 If the contents of R3 on the CRT are not +00000, enter the following sequence into K148:
- VERB 22, ENTER
 - +00000, ENTER
- 6.2.16.7.10 If the contents of R3 on the CRT are not +00001, enter the following sequence into K148:
- VERB 23, ENTER
 - +00001, ENTER
- 6.2.16.7.11 Verify correct display in R1, R2, and R3. Enter VERB 33 into K148. Press the ENTER pushbutton.
- 6.2.16.7.12 After approximately 17 minutes, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the value on CRT for R2 on the calculation sheet.
- 6.2.16.7.13 Enter VERB 33 into K148. Press the ENTER pushbutton.
- 6.2.16.7.14 After approximately 90 sec, VERB 06, NOUN 66 shall appear flashing on the CRT. Record the value on CRT for R1 and R2 on the calculation sheet.
- 6.2.16.7.15 Enter VERB 34 into K148. Press the ENTER pushbutton.
- 6.2.16.7.16 Repeat steps 6.2.16.3.7 through 6.2.16.3.14, substituting position number +00002 in R3.
- 6.2.16.7.17 Enter VERB 33 into K148. Press ENTER pushbutton.
- 6.2.16.7.18 After approximately 67 minutes, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the value on CRT for R2 on the calculation sheet.
- 6.2.16.7.19 Repeat steps 6.2.16.3.6 through 6.2.16.3.14, substituting position number +00003 in R3.
- 6.2.16.7.20 Repeat steps 6.2.16.3.15 through 6.2.16.3.18, substituting position number +00004 in R3.
- 6.2.16.7.21 Enter VERB 33 into K148. Press ENTER pushbutton.

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6.2.16.7.22 VERB 06 NOUN 66 shall flash on the CRT. Verify the following data is also displayed on the CRT.

- a. R1 = +00900
- b. R2 = +00000
- c. R3 = +00005

If data is incorrect perform steps 6.2.16.3.8 thru 6.2.16.3.10 entering the correct data. Enter VERB 33 into K148. Press ENTER pushbutton.

The PROGRAM ALARM and GIMBAL LOCK status lights shall be illuminated on the DSKY.

6.2.16.7.23 Press the RESET pushbutton. The Program Alarm lamp shall extinguish. In approximately 90 sec, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the data displayed in R1 and R2 on the CRT.

6.2.16.7.24 Enter VERB 34 into K148. Press ENTER pushbutton. Repeat steps 6.2.16.3.22 thru 6.2.16.3.23 substituting position no. +00006.

6.2.16.7.25 Enter VERB 34 into K148. Press the ENTER pushbutton. VERB 06 NOUN 66 shall flash on the CRT. Verify the following data is also displayed on the CRT.

- a. R1 = +00900
- b. R2 = +00000
- c. R3 = +00007

If the data is incorrect perform steps 6.2.16.3.8 thru 6.2.16.3.10 entering the correct data.

6.2.16.7.26 Enter VERB 33 into K148. Press ENTER pushbutton. The GIMBAL LOCK status lamp shall extinguish. In approximately 17 minutes VERB 06 NOUN 66 shall flash on the CRT. Record the data displayed in R2 of the CRT.

6.2.16.7.27 Repeat steps 6.2.16.3.25 and 6.2.16.3.26 substituting position no. +00008 in R3.

6.2.16.7.28 Repeat steps 6.2.16.3.25 and 6.2.16.3.26 substituting position no. +00009 in R3.

6.2.16.7.29 Repeat steps 6.2.16.3.25 and 6.2.16.3.26 substituting position no. +00010 in R3.

6.2.16.8 To terminate the IMU Performance Test, enter VERB 36 into K148. Press ENTER pushbutton.

6.2.16.9 Enter the following sequence in K148.

- a. VERB 40 NOUN 20, ENTER
- b. VERB 41 NOUN 20, ENTER
- c. +00000, ENTER
- d. +00000, ENTER
- e. +00000, ENTER

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6.2.16.10 Calculations

Table XXI

Position No. As Displayed in R3	Quantity Being Measured
+00001	+HEDY +X PIPA G
+00002	+HEDZ -X PIPA G -HEDX + ADIAX
+00003	-HEDX +Z PIPA G
+00004	+HEDY + ADERAY -Z PIPA G +HEDZ + ADIAZ
+00005	+ Y PIPA G
+00006	- Y PIPA G
+00007	-HEDX + .707 ADERAX
+00008	.707 (-HEDZ - HEDY) + .5 (ADIAZ - ADIAY) +.5 (ADERAY + ADERAZ)
+00009	-HEDZ + .707 ADERAZ
+00010	.707 (HEDY - HEDX) + .5 (ADIAY - ADIAX) +.5 (ADERAX)

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6.2.16.10.1 Measured Values

	Line	Position No.	Step No.	Parameter	Recorded Value
6.2.16.10.1.1	1	+00001	6.2.16.7.12	+NBDY	R2
6.2.16.10.1.2	2	+00001	6.2.16.7.14	+XPIPAG	R1 . R2
6.2.16.10.1.3	3	+00002	6.2.16.7.12	+NBDZ	R2
6.2.16.10.1.4	4	+00002	6.2.16.7.14	-XPIPAG	R1 . R2
6.2.16.10.1.5	5	+00002	6.2.16.7.18	-NBDX + ADIAZ	R2
6.2.16.10.1.6	6	+00003	6.2.16.7.12	-NBDX	R2
6.2.16.10.1.7	7	+00003	6.2.16.7.14	+ZPIPAG	R1 . R2
6.2.16.10.1.8	8	+00004	6.2.16.7.12	+NBDY + ADSRAY	R2
6.2.16.10.1.9	9	+00004	6.2.16.7.14	-ZPIPAG	R1 . R2
6.2.16.10.1.10	10	+00004	6.2.16.7.18	+NBDZ + ADIAZ	R2
6.2.16.10.1.11	11	+00005	6.2.16.7.23	+YPIPAG	R1 . R2
6.2.16.10.1.12	12	+00006	6.2.16.7.23	-YPIPAG	R1 . R2
6.2.16.10.1.13	13	+00007	6.2.16.7.26	-NBDX + .707ADGRAX	R2
6.2.16.10.1.14	14	+00008	6.2.16.7.26	.707 (-NBDZ - NBDY) + .5 (ADIAZ - ADIAY) + .5 (ADSRAY + ADSRAZ)	R2
6.2.16.10.1.15	15	+00009	6.2.16.7.26	-NBDZ + .707ADGRAZ	R2
6.2.16.10.1.16	16	+00010	6.2.16.7.26	.707(NBDY - NBDX) + .5 (ADIAY - ADIAZ) + .5 ADSRAX	R2

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6.2.16.10.2

Compute the average G for each PIPA using the recorded values in 6.2.16.6.1

a. For XPIPA, $G_x = \frac{\text{line 2} - \text{line 4}}{2} =$

b. For YPIPA, $G_y = \frac{\text{line 11} - \text{line 12}}{2} =$

c. For ZPIPA, $G_z = \frac{\text{line 7} - \text{line 9}}{2} =$

6.2.16.10.3

Compute the PIPA scale factor from the values obtained in 6.2.16.6.2 and the value of local gravity obtained from Table XIII as follows:

a. $h_x = \frac{5.85(\text{local } g)}{G_x} =$

b. $h_y = \frac{5.85(\text{local } g)}{G_y} =$

c. $h_z = \frac{5.85(\text{local } g)}{G_z} =$

6.2.16.10.3.1

The PIPA scale factor shall be 5.85000 ± 0.00234 cm/sec/pulse.

Table XIII. Local Gravity Requirements

Location	Local Gravity (cm/sec ²)
HAA	979.56
MSC	979.29
MILA	979.24

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6.2.16.10.4 Compute the FIPA bias values using the values obtained in 6.2.16.6.2 as follows:

a. $b_x = \frac{\text{line 2} + \text{line 4}}{2} =$

b. $b_y = \frac{\text{line 11} + \text{line 12}}{2} =$

c. $b_z = \frac{\text{line 7} + \text{line 9}}{2} =$

10
6.2.16.10.4.1 The FIPA bias values shall not exceed 0.50 cm/sec².

6.2.16.10.5 Calculate NED, ADSRA, ADIA using the values obtained in 6.2.16.6.2.

a. $NEDX = -(\text{line 6}) =$
 $NEDY = \text{line 1} =$
 $NEDZ = +(\text{line 3}) =$

b. $ADSRAX = \frac{(\text{line 13} - \text{line 6})}{.707}$
 $ADSRAY = \text{line 8} - \text{line 1}$
 $ADSRZ = \frac{+\text{line 15} + \text{line 3}}{.707}$

c. $ADIAX = \text{line 5} - \text{line 6}$
 $ADIAZ = \frac{\text{line 16} - .707(NEDY - NEDX) - .5(ADSRAX - ADIAZ)}{.5}$
 $ADIAZ = \text{line 10} - \text{line 3}$

6.2.16.10.5.1 Obtain the following values from the latest performance of JDC 12217 at AC Electronics.

a. $NEDX =$ _____ $neru$
 $NEDY =$ _____ $neru$
 $NEDZ =$ _____ $neru$

b. $ADSRAX =$ _____ $neru$
 $ADSRAY =$ _____ $neru$
 $ADSRZ =$ _____ $neru$

c. $ADIAZ =$ _____ $neru$
 $ADIAZ =$ _____ $neru$
 $ADIAZ =$ _____ $neru$

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6.2.16.7.6

Calculate MBD, ADSRA, and ADIA by taking the differences between the respective MBD, ADSRA, and ADIA terms in 6.2.16.5 and 6.2.16.5.1.

- a. MBDX = _____ meru
 MBDY = _____ meru
 MBDZ = _____ meru
- b. ADSRAX = _____ meru
 ADSRAY = _____ meru
 ADSRAZ = _____ meru
- c. ADIAX = _____ meru
 ADIAY = _____ meru
 ADIAZ = _____ meru

MBD shall not exceed ± 5 meru.

ADSRA shall not exceed ± 10 meru.

ADIA shall not exceed ± 15 meru.

6.2.16.7.6.1

Evaluate results to determine IMJ Performance Test passed or failed.

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6.2.17 SXT-MB-IMU Fine Alignment Test

6.2.17.1 Proceed with this test if the Operate Power On Test 6.2.3 has been completed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2.

6.2.17.2 Prior to performing this test, the G&N Installation Qualification fixture shall be installed on the supporting fixture and adjusted to permit proper operation of the G&N optics. The azimuth supplied by the azimuth autotest (Optical Reference No. 1) shall be known to ± 30 minutes of arc.

NOTE: The G&N shall have had OPERATE power applied for a minimum of 1 hour.

6.2.17.3 Enter VERB 01 NOUN 10 into K148 Press the ENTER pushbutton. Record R1 = AAAAA and the time of day.

6.2.17.4 Enter VERB 21 NOUN 02 into K148 press the ENTER pushbutton. Enter AAAAA into K148. Press ENTER.

6.2.17.5 Enter VERB 06, NOUN 02 into K148. Press ENTER. Enter 01300 into K148. Press ENTER. Record R1 = BBBB.

6.2.17.6 Perform the following calculations:

a.
$$\frac{R1 (BBBB) \times 5.12}{3600} = CCCC.C \text{ (Hrs. in high order scaler channel 3)}$$

b. $23.3 - CCCC.C = DDDDD \text{ Hrs.}$

c. Add DDDDD to time of day recorded in step 1.

DO NOT enter any of the PIPA misalignment tests within -0.2 hours of the time of day calculated in step 6.2.16.5c. This is the time at which the high order scaler, channel 3, will overflow. If a PIPA misalignment test is being performed at this time, unacceptable test results will occur.

6.2.17.7 Enter the following sequence into the Lower Equipment Bay (LEB) DSKY.

- a. VERB 41 NOUN 20 ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

6.2.17.8 On the G&N Indicator Control Panel set the following switches to the position indicated.

- a. TELESCOPE TRUNNION to SLAVE to SXT
- b. CONTROLLER COUPLING to DIRECT
- c. CONTROLLER SPEED to 10
- d. OPTICS MODE to ZERO

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6.2.17.9 Initiate the test by entering the following sequence into the LEB DSKY.

- a. VERB 57, ENTER
- b. 00003, ENTER

6.2.17.10 Observe VERB 06 NOUN 66 flashing on the DSKY. The following data is displayed in R1 and R2 on the DSKY.

- a. R1 = +13500
- b. R2 = +xx.xxx (Site Latitude from Table I)

Table 1

Test Site	Latitude
NAA	+33.922
MILA	+28.516
MBC	+29.556

6.2.17.11 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If the value displayed is other than +13500 in R1 and the correct Site Latitude in R2, correct the data by entering the following sequence into the DSKY.

- a. VERB 21, ENTER
- b. +13500, ENTER
- c. VERB 22, ENTER
- d. +xx.xxx, ENTER (+xx.xxx = Site Latitude from Table I)
- e. VERB 33, ENTER

6.2.17.12 Observe VERB 21 NOUN 30 flashing on the DSKY. Enter the following sequence into the DSKY.

- a. +00001, ENTER (Position Number)
- b. +00000, ENTER
- c. +00001, ENTER

6.2.17.13 Observe VERB 06 NOUN 66 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.

- a. R1 = +xxx.xx (Y_{NB} Azimuth)
- b. R2 = +xx.xxx (Y_{NB} Elevation)
- c. R3 = 00001

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- 6.2.17.14 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct Y_{NB} azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx \pm 002.00 degrees, ENTER (Y_{NB} azimuth)
 - +xx.xxx \pm 02.000 degrees, ENTER (Y_{NB} elevation)
 - VERB 33, ENTER
- 6.2.17.15 Observe VERB 06 NOUN 66 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Z_{NB} Azimuth)
 - R2 = +xx.xxx (Z_{NB} Elevation)
 - R3 = 00002
- 6.2.17.16 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct Z_{NB} azimuth and elevation, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx \pm 002.00 degrees, ENTER (Z_{NB} Azimuth)
 - +xx.xxx \pm 02.000 degrees, ENTER (Z_{NB} elevation)
 - VERB 33, ENTER
- 6.2.17.17 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Target 1 Azimuth)
 - R2 = +xx.xxx (Target 1 Elevation)
 - R3 = 00001
- 6.2.17.18 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct azimuth and elevation for Target 1, correct the data by entering the following sequence into the DSKY.
- VERB 24, ENTER
 - +xxx.xx \pm 000.10 degrees, ENTER (Target 1 Azimuth)
 - +xx.xxx \pm 00.010 degrees, ENTER (Target 1 Elevation)
 - VERB 33, ENTER
- 6.2.17.19 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.
- R1 = +xxx.xx (Target 2 Azimuth)
 - R2 = +xx.xxx (Target 2 Elevation)
 - R3 = 00002
- 6.2.17.20 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct azimuth and elevation for Target 2, correct the data by entering the following sequence into the DSKY.

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- a. VERB 24, ENTER
- b. +xxx.xx + 000.10 degrees, ENTER (Target 2 Azimuth)
- c. +xx.xxx + 00.010 degrees, ENTER (Target 2 Elevation)
- d. VERB 33, ENTER

- 6.2.17.21 When VERB 51 NOUN 30 flashes on the DSKY set the OPTICS MODE switch on the G&N Indicator Control Panel to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.
- 6.2.17.22 Using the Optics Hand Controller, align the SXT StLOS with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.23 When VERB 51 NOUN 30 flashes on the DSKY set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.
- 6.2.17.24 Using the Optics Hand Controller, align the SXT StLOS with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.
- 6.2.17.25 Repeat steps 6.2.17.17 through 6.2.17.20.
- 6.2.17.26 In approximately 7 minutes VERB 06 NOUN 66 shall flash on the DSKY and the test results shall be displayed. R1 and R2 on the DSKY shall display the misalignment of one of the horizontal PIPA's in arc seconds (R1 = whole, R2 = fractional). Record R1 and R2. (See Table II for PIPA displayed).
- 6.2.17.27 Enter VERB 33 ENTER into the DSKY. When VERB 06 NOUN 66 flashes R1 and R2 on the DSKY shall display the misalignment of the second horizontal PIPA in arc seconds (R1 whole, R2 fractional). (See Table II for PIPA displayed.) Record R1 and R2.

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6.2.17.28 Enter VERB 34 ENTER into the DSKY to terminate the test.

6.2.17.29 Repeat steps 6.2.17.4 through 6.2.17.24 substituting position No. 00002 in 6.2.17.8a.

6.2.17.30 Enter the following sequence into the DSKY:

- a. VERB 41 NOUN 20, ENTER
- b. +00000, ENTER
- c. +00000, ENTER
- d. +00000, ENTER

Table II. Display Conditions at Test Completion

Position	SM Orientation			6.2.17.22	6.2.17.23
	X _{SM}	Y _{SM}	Z _{SM}		
1	UP	SW	SE	Y PIPA about Z PIPA	Z PIPA about X PIPA
2	SE	SW	DW	X PIPA about Y PIPA	Y PIPA about X PIPA
3 *	SE	UP	SW	X PIPA about Z PIPA	Z PIPA about X PIPA

* Position 3 is not run in the Spacecraft because of GIMBAL LOCK considerations.

6.2.17.31 Calculations

- 6.2.17.31.1
 - a. YPIPA about Z misalignment = $\left\{ \begin{array}{l} R1 \\ R2 \end{array} \right\}$
 - b. ZPIPA about Y misalignment = $\left\{ \begin{array}{l} R1 \\ R2 \end{array} \right\}$
 - c. XPIPA about Y misalignment = $\left\{ \begin{array}{l} R1 \\ R2 \end{array} \right\}$
 - d. YPIPA about X misalignment = $\left\{ \begin{array}{l} R1 \\ R2 \end{array} \right\}$

6.2.17.31.2 Enter the latest values from 6.2.16 IMU Performance Test.

- a. X PIPA bias = _____ cm/sec²
- b. Y PIPA bias = _____ cm/sec²
- c. Z PIPA bias = _____ cm/sec²
- d. $\theta_x = 210$ (X PIPA bias) = _____ arc sec.
- e. $\theta_y = 210$ (Y PIPA bias) = _____ arc sec.
- f. $\theta_z = 210$ (Z PIPA bias) = _____ arc sec.

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6.2.17.3L3

- a. Y PIPA about Z misalignment (Bias corrected) =
6.2.17.27.1a - θ_y = _____ arc sec.
- b. Z PIPA about Y misalignment (Bias corrected) =
6.2.17.27.1b - θ_z = _____ arc sec.
- c. X PIPA about Y misalignment (Bias corrected) =
6.2.17.27.1c - θ_x = _____ arc sec.
- d. Y PIPA about X misalignment (Bias corrected) =
6.2.17.27.1d - θ_y = _____ arc sec.

The PIPA misalignments, excluding PIPA bias, shall not exceed ± 150 arc seconds.

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6.2.18 Gyrocompassing Test

- 6.2.18.1** Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure.
- 6.2.18.2** Enter the following sequence into the K-Start, pressing **ENTER** pushbutton after each entry.
- a. VERB 57, **ENTER**
 - b. 00006, **ENTER**
- 6.2.18.3** System shall advance to Gyrocompass. System Test and display 01 on the CRT program display.
- 6.2.18.4** On the CRT observe VERB 06, NOUN 61 flashing with some launch azimuth displayed in R1 = +xxx.xx.
- 6.2.18.4.1** If the azimuth displayed is correct proceed to 6.2.18.5; if not, perform the following sequence:
- a. VERB 21, Press **ENTER** pushbutton
 - b. +xxx.xx, press **ENTER** pushbutton (Correct Launch Azimuth)
- 6.2.18.5** After verifying that the correct launch azimuth is displayed in R1 on the CRT, Enter VERB 33 on the K-START and push the **ENTER** pushbutton.
- 6.2.18.6** Observe VERB 06 NOUN 61 flashing on the CRT with the following displayed in R1 and R2.
- a. R1 = +xxx.xx, Nav. Base Azimuth (Z_{NB})
 - b. R2 = +xx.xxx, Site Latitude
- 6.2.18.6.1** Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence:
- To correct R1:
- a. VERB 21, **ENTER**
 - b. +xxx.xx + 000.50 degrees, **ENTER** (Z_{NB} Azimuth)
- To correct R2:
- a. VERB 22, **ENTER**
 - b. +xx.xxx, **ENTER** (Correct Site Latitude from Table I)

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- 6.2.18.7 After the correct data for R1 and R2 are verified enter VERB 33 into the K-Start. Press the ENTER pushbutton. On the CRT observe the PROGRAM display change to 05 after approximately 90 seconds. After approximately 15 minutes, observe the PROGRAM display change to 02.
- 6.2.18.8 After 120 minutes set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.9 Enter VERB 52 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT change to 03.
- 6.2.18.10 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 1 azimuth and elevation.
- R1 = +xxx.xx (Target 1 azimuth)
 - R2 = +00.000 (Target 1 elevation)
- 6.2.18.11 Verify the data appearing in R1 and R2 and if correct, proceed. If not correct, perform the following sequence.
- VERB 24, ENTER
 - +xxx.xx + 000.01, ENTER (Target 1 azimuth)
 - +00.000, ENTER (Target 1 elevation)
- 6.2.18.12 After the correct readings for R1 and R2 are verified, enter VERB 33 into the K-Start. Press the ENTER pushbutton.
- 6.2.18.13 When VERB 06 NOUN 61 flash on the CRT and DSKY's, insure that R1 and R2 display Target 2 azimuth and elevation.
- R1 = +xxx.xx (Target 2 azimuth)
 - R2 = +00.000 (Target 2 elevation)
- 6.2.18.14 Verify the data appearing in R1 and R2 and if correct proceed. If not correct, perform the following sequence.
- VERB 24, ENTER
 - +xxx.xx + 000.01, ENTER (Target 2 azimuth)
 - +00.000, ENTER (Target 2 elevation)
- 6.2.18.15 After the correct readings for R1 and R2 are verified enter VERB 33 into the K-Start. Press the ENTER pushbutton.

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- 6.2.18.16 On the G&N Indicator Control Panel set the OPTICS MODE switch to MAN and the CONTROLLER SPEED to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target 1.
- 6.2.18.17 Set the CONTROLLER SPEED switch on the G&N Indicator Control Panel to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 1 and press the MARK pushbutton. If satisfied that the MARK was good, proceed. If not satisfied with MARK, press the MARK REJECT pushbutton and repeat the step.
- 6.2.18.18 Set the CONTROLLER SPEED switch to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target 2.
- 6.2.18.19 Set the CONTROLLER SPEED switch to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 2 and press the MARK pushbutton. If satisfied that the MARK was good, press the ENTER pushbutton. If not satisfied, press the MARK REJECT pushbutton and repeat this step.
- 6.2.18.20 On the CRT observe the following data displayed:
- VERB 06 HOUR 60
 - R1 = +xx.xxx (X gyre elevation error, degrees)
 - R2 = +xx.xxx (Y gyre elevation error, degrees)
 - R3 = +xx.xxx (Z gyre azimuth error, degrees)
- Record R1, R2 and R3.
- 6.2.18.21 Enter VERB 34 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT and DSKY's indicates G2. Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.
- 6.2.18.22 Repeat steps 6.2.18.9 through 6.2.18.21 for the next hour at the following intervals.
- 15 minutes
 - 30 minutes
 - 45 minutes
 - 60 minutes

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6.2.18.23 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

6.2.18.24 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start three times. Press the ENTER pushbutton after each entry.

6.2.18.25 Data Sheet

Line	Step No.	Parameter	Recorded Value
	6.2.18.20		
1		X Gyre Elevation Error	+ $\frac{R_1}{R_2}$ degrees
2		Y Gyre Elevation Error	+ $\frac{R_2}{R_3}$ degrees
3		Z Gyre Azimuth Error	+ $\frac{R_3}{R_4}$ degrees
	6.2.18.22a		
4		X Gyre Elevation Error	+ $\frac{R_1}{R_2}$ degrees
5		Y Gyre Elevation Error	+ $\frac{R_2}{R_3}$ degrees
6		Z Gyre Azimuth Error	+ $\frac{R_3}{R_4}$ degrees
	6.2.18.22b		
7		X Gyre Elevation Error	+ $\frac{R_1}{R_2}$ degrees
8		Y Gyre Elevation Error	+ $\frac{R_2}{R_3}$ degrees
9		Z Gyre Azimuth Error	+ $\frac{R_3}{R_4}$ degrees
	6.2.18.22c		
10		X Gyre Elevation Error	+ $\frac{R_1}{R_2}$ degrees
11		Y Gyre Elevation Error	+ $\frac{R_2}{R_3}$ degrees
12		Z Gyre Azimuth Error	+ $\frac{R_3}{R_4}$ degrees
	6.2.18.22d		
13		X Gyre Elevation Error	+ $\frac{R_1}{R_2}$ degrees
14		Y Gyre Elevation Error	+ $\frac{R_2}{R_3}$ degrees
15		Z Gyre Azimuth Error	+ $\frac{R_3}{R_4}$ degrees

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6.2.18.26 Calculations Sheet

6.2.18.26.1 Record the most recent values of the following coefficients from 6.2.16, IMJ Performance Test.

- a. NEDX = () _____
 b. NEDY = () _____
 c. NEDZ = () _____
 d. ADIAZ = () _____
 e. ADSRAY = () _____

6.2.18.26.2 Perform the following calculations. (Cos λ functions are provided in Table I.)

- a. $D(\text{vert}) = \text{NEDZ} - \text{ADIAZ}$
 $D(\text{vert}) = ()$ _____ nautical miles
 b. $D(\text{east}) = \begin{matrix} \sin (\text{Launch Azimuth}) & \text{NEDX} + \\ \cos (\text{Launch Azimuth}) & \text{NEDY} + \text{ASRAY} \end{matrix}$
 c. $\phi(\text{vert}) = \frac{D(\text{vert}) \times 24.2 + D(\text{east}) \times 206.26981}{3600 (\text{Cos } \lambda)}$
 $\phi(\text{vert}) = ()$ _____ degrees

Table I

Location	Latitude λ	Cos λ
HAA	33.917	0.82985
MILA	28.516	0.87868
MSC	29.556	0.86993

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6.2.18.26.3

Perform the following calculations using the recorded data from 6.2.18.25 and 6.2.18.26.2.

- a. Z Gyre azimuth error 2 hrs (corrected) = line 3 - ϕ (vert)
 Z Gyre azimuth error 2 hrs (corrected) = _____
 Corrected Z Gyre azimuth error (corrected) shall be 0.00 ± 0.57 degrees
- b. X Gyre elevation error (2 hr) = line 1
 X Gyre elevation error (2 hr) = _____ degrees
- c. Y Gyre elevation error (2 hr) = line 2
 Y Gyre elevation error (2 hr) = _____ degrees
 The X and Y Gyre elevation errors shall be 0.00 ± 0.03 degrees.
- d. Δ Z Gyre azimuth error (3 hr) = line 3 - line 15
 Δ Z Gyre azimuth error (3 hr) = _____ degrees
 Δ Z Gyre azimuth error shall be 0.00 ± 0.06 degrees.
- e. Δ X Gyre elevation error (3 hr) = line 1 - line 13
 Δ X Gyre elevation error (3 hr) = _____ degrees
- f. Δ Y Gyre elevation error (3 hr) = line 2 - line 14
 Δ Y Gyre elevation error (3 hr) = _____ degrees
 Δ X and Δ Y Gyre elevation error shall be 0.00 ± 0.03 degrees.

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6.2.19 CMC Voltage Margin Test

6.2.19.1 Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 Turn On Procedure.

6.2.19.2 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to ON.

Caution: During the performance of this test the +4 VDC CMC Power Supply shall not be operated at less than +2.5 VDC or greater than 5.2 VDC (CG 1030). The +14 VDC CMC Power Supply shall not be operated at less than +8.5 VDC or greater than +17.0 VDC (CG 1020).

Note: The flashing indication of the CMC Power Supplies on CRT may be disregarded for this test. The charts in Table I may be used to determine approximate values for the "XX.X" values of 0-156 voltage dial settings corresponding to various power supply voltages.

6.2.19.3 Units R-154 insert 0111. Verify and execute.

6.2.19.4 Insert in 0-156 + XX.X001244 (Enter a value for XX.X which will adjust the +14 VDC Power Supply (CG1020) to 12.2 (+0.3, -0.0) VDC). Execute. Verify CG1020 on the CRT.

6.2.19.5 Insert in 0-156 + XX.X001234 (Enter a value for XX.X which will adjust the +4 VDC Power Supply (CG1030) to 3.5 (+0.15, -0.0) VDC). Execute. Verify CG1030 on the CRT.

6.2.19.6 On K-148 press ERROR RESET

6.2.19.7 Initiate CMC Self-Check by inserting the following into K-148.

- a. VERB 21 NOUN 27, ENTER
- b. 77777, ENTER

Wait 200 seconds. Verify RESTART lamp on DEKY is not lighted.

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- 6.2.19.8 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on DSKY is lighted.
- 6.2.19.9 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to ON. Press ERROR RESET. Insert into K-148;
- a. VERB 21, NOUN 27, ENTER
b. TTTTT, ENTER
- 6.2.19.10 Insert into C-156 + XX.X001244 (Enter a value for XX.X which will adjust the $+1\frac{1}{4}$ VDC OMC Power Supply (CG1020) to +16.4 (0.0, -0.4) VDC). Execute. Verify CG1020 on the CRT.
- 6.2.19.11 Press ERROR RESET on K-148. Wait 200 seconds. Verify RESTART lamp on DSKY is not lighted.
- 6.2.19.12 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to off. Verify RESTART lamp on the DSKY is lighted. Set the INHIBIT VOLTAGE FAIL switch to ON. Press ERROR RESET. Insert into K-148.
- a. VERB 21 NOUN 27, ENTER
b. TTTTT, ENTER
- 6.2.19.13 Insert into C-156 + XX.X001234 (Enter a value for XX.X which will adjust the $+4$ VDC OMC Power Supply (CG1030) to 4.6 (+0.0, -0.2) VDC). Execute. Verify CG1030 on the CRT.
- 6.2.19.14 Press ERROR RESET on K-148. Wait 200 seconds. Verify RESTART lamp on DSKY is not lighted
- 6.2.19.15 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on the DSKY is lighted. Set the INHIBIT VOLTAGE FAIL switch to on. Press ERROR RESET. Insert into K-148.
- a. VERB 21 NOUN 27, ENTER
b. TTTTT, ENTER
- 6.2.19.16 Insert into C-156 + XX.X001244 (Enter a value for XX.X which will adjust the $+1\frac{1}{4}$ VDC OMC Power Supply (CG1020) to 12.2 (+0.3, -0.0) VDC). Execute. Verify CG1020 on the CRT.

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6.2.19.17 Press ERROR RESET on K-148. Wait 200 seconds. Verify RESTART lamp on the DSKY is not lighted.

6.2.19.18 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on the DSKY is lighted.

6.2.19.19 Into R-154 insert 0000. Verify and execute.

6.2.19.20 Terminate the CMC Self-Check by inserting into K-148:

- a. VERB 21 NOUN 27, ENTER
- b. 00000, ENTER

Press ERROR RESET on K-148.

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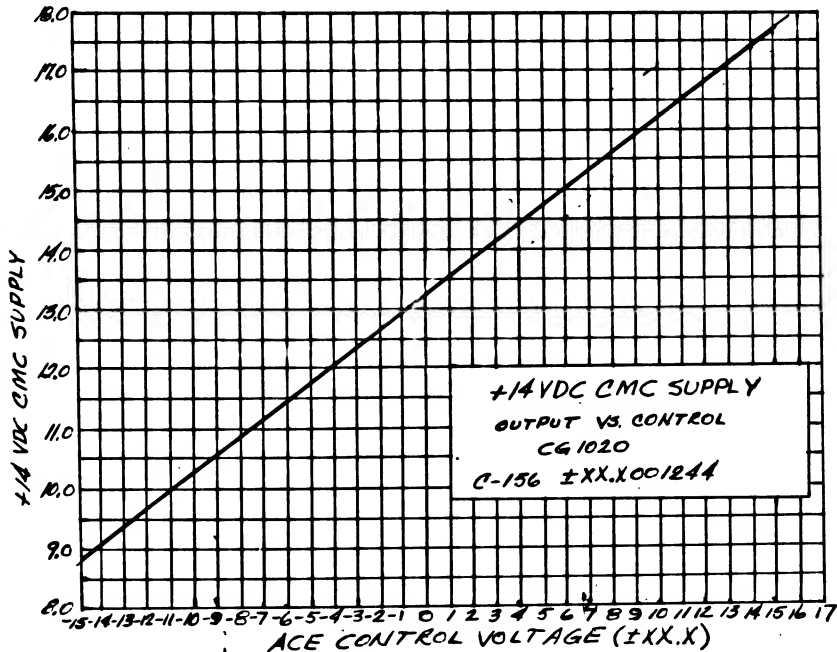
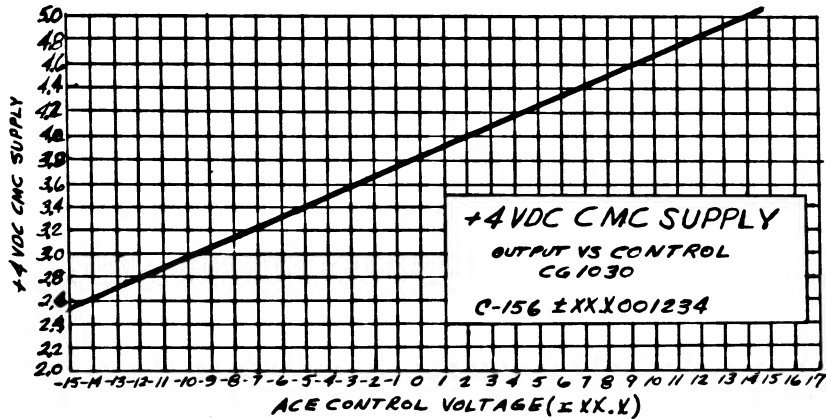


TABLE I

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6.2.21 Spacecraft Control and Displays Test

6.2.21.1 Proceed with this test if the Operate Power On Test of 6.2.3 and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 before proceeding.

6.2.21.2 FDAI Attitude Error

6.2.21.2.1 Insert in K148

- a. V 57 ENTER
b. 00013 ENTER

6.2.21.2.2 Observe on CRT

- a. V 33 NO1 Flashing
b. PROG 07
c. NO ATT ON
d. R1, R2, and R3 Approx. 00000

6.2.21.2.3 Insert in K148

- a. ENTER

6.2.21.2.4 Observe on CRT

- a. V 33 NO1 Flashing
b. R1 +00385
c. R2 -00385
d. R3 +00385
e. NO ATT OFF

6.2.21.2.5 Record CRT indications

- a. CG 2279 ROLL ATT ERROR - CDU DAC OUT $+16.88 \pm 1.65$ degrees
b. CG 2219 PITCH ATT ERROR - CDU DAC OUT -16.88 ± 1.65 degrees
c. CG 2249 YAW ATT ERROR - CDU DAC OUT $+16.88 \pm 1.65$ degrees

6.2.21.2.6 Insert in K148

- a. ENTER

6.2.21.2.7 Observe on CRT

- a. V 33 NO1 Flashing
b. R1 +00384
c. R2 -00384
d. R3 +00384

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6.2.21.2.8 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	+16.88 ±1.65 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	+16.88 ±1.65 degrees

6.2.21.2.9 Insert in K148

a. ENTER

6.2.21.2.10 Observe on CRT

a. V 33	NO1	Flashing
b. R1		+00160
c. R2		-00160
d. R3		+00160

6.2.21.2.11 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	+6.95 ±0.69 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	-6.95 ±0.69 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	+6.95 ±0.69 degrees

6.2.21.2.12 Insert in K148

a. ENTER

6.2.21.2.13 Observe on CRT

a. V 33	NO1	Flashing
b. R1		+00135
c. R2		-00135
d. R3		+00135

6.2.21.2.14 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	+5.88 ±0.59 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	-5.88 ±0.59 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	+5.88 ±0.59 degrees

6.2.21.2.15 Insert in K148

a. ENTER

6.2.21.2.16 Observe on CRT

a. V 33	NO1	Flashing
b. R1		+00090
c. R2		-00090
d. R3		+00090

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6.2.21.2.17 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	+3.93 ±0.39 degrees
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	-3.93 ±0.39 degrees
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	+3.93 ±0.39 degrees

6.2.21.2.18 Insert in K148

a. ENTER

6.2.21.2.19 Observe on CRT

a.	V 33	NO1	Flashing
b.	R1		+00000
c.	R2		+00000
d.	R3		-00090

6.2.21.2.20 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	0.00 ±0.19 degrees
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	0.00 ±0.19 degrees
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	-3.93 ±0.39 degrees

6.2.21.2.21 Insert in K148

a. ENTER

6.2.21.2.22 Observe on CRT

a.	V 33	NO1	Flashing
b.	R1		-00090
c.	R2		+00090
d.	R3		-00135

6.2.21.2.23 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	-3.93 ±0.39 degrees
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	+3.93 ±0.39 degrees
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	-5.88 ±0.59 degrees

6.2.21.2.24 Insert in K148

a. ENTER

6.2.21.2.25 Observe on CRT

a.	V 33	NO1	Flashing
b.	R1		-00135
c.	R2		+00135
d.	R3		-00160

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6.2.21.2.26 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	-5.88 ±0.59 degrees
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	+5.88 ±0.59 degrees
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	-6.95 ±0.69 degrees

6.2.21.2.27 Insert in K148

a. ENTER

6.2.21.2.28 Observe on CRT

a.	V 33	N01	Flashing
b.	R1		-00160
c.	R2		+00160
d.	R3		-00384

6.2.21.2.29 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	-6.95 ±0.69 degrees
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	+6.95 ±0.69 degrees
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees

6.2.21.2.30 Insert in K148

a. ENTER

6.2.21.2.31 Observe on CRT

a.	V 33	N01	Flashing
b.	R1		-00384
c.	R2		+00384
d.	R3		-00385

6.2.21.2.32 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	+16.88 ±1.65 degrees
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees

6.2.21.2.33 Insert in K148

a. ENTER

6.2.21.2.34 Observe on CRT

a.	V 33	N01	Flashing
b.	R1		-00385
c.	R2		+00385
d.	R3		+00000

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6.2.21.2.35 Record CRT indications

a. CG 2279	ROLL ATT ERROR - CDU DAC OUT	-16.88 ±1.65 degrees
b. CG 2219	PITCH ATT ERROR - CDU DAC OUT	+16.88 ±1.65 degrees
c. CG 2249	YAW ATT ERROR - CDU DAC OUT	0.00 ±0.19 degrees

6.2.21.2.36 Insert in K148

a. V 21	NO1	ENTER
b. 02545		ENTER
c. 03302		ENTER
d. V 33		ENTER

6.2.21.2.37 Observe on CRT

a. V 33	NO3	Flashing
b. NO ATT		ON
c. R1		+00000 approximately
d. R2		+00000 approximately
e. R3		+00000 approximately

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6.2.21.3 TVC Test

6.2.21.3.1 The G/N Autopilot Control and SPS Ready discretes shall be applied to the G/N interface.

6.2.21.3.2 Set the OPTICS MODE selector on the Indicator Control panel to MAN.

6.2.21.3.3 Insert in K148

a. ENTER

6.2.21.3.4 Observe on CRT

a. V 01	N 10	Flashing
b. R1		X7373
c. R3		00030

6.2.21.3.5 Insert in K148

a. V 33 ENTER

6.2.21.3.6 Observe on CRT

a. V 01	NOUN 10	Flashing
b. R1		37777
c. R3		00031

6.2.21.3.7 Insert in K148

a. V 33 ENTER

6.2.21.3.8 Observe on CRT

a. V 33	N 03	Flashing
b. R1		+00385
c. R2		-00385
d. R3		+00003

6.2.2.3.9 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+16.88 ±1.00 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-16.88 ±1.00 degrees

6.2.21.3.10 Insert in K148

a. ENTER

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6.2.21.3.11 Observe on CRT

a. V 33	N 03	Flashing
b. R1		+00384
c. R2		-00384
d. R3		+00003
e. NO ATT		OFF

6.2.21.3.12 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+16.88 ±1.00 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-16.88 ±1.00 degrees

6.2.21.3.13 Insert in K148

a. ENTER

6.2.21.3.14 Observe on CRT

a. V 33	N 03	Flashing
b. R1		+00160
c. R2		-00160
d. R3		+00003

6.2.21.3.15 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+6.95 ±0.41 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-6.95 ±0.41 degrees

6.2.21.3.16 Insert in K148

a. ENTER

6.2.21.3.17 Observe on CRT

a. V 33	N 03	Flashing
b. R1		+00135
c. R2		-00135
d. R3		+00003

6.2.21.3.18 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+5.88 ±0.35 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-5.88 ±0.35 degrees

6.2.21.3.19 Insert in K148

a. ENTER

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6.2.21.3.20 Observe on CRT

a. V 33	N 03	Flashing
b. R1		+00090
c. R2		-00090
d. R3		+00003

6.2.21.3.21 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	+3.93 \pm 0.24 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	-3.93 \pm 0.24 degrees

6.2.21.3.22 Set the OPTICS CONTROLLER SPEED Switch on the Indicator Control panel to HI.

6.2.21.3.23 Insert in K148

a. ENTER

6.2.21.3.24 Observe on CRT

a. V 33	N 03	Flashing
b. R1		+00000
c. R2		+00000
d. R3		+00003

6.2.21.3.25 While holding the Optics Hand Controller up and left (45°) no longer than 10 seconds, record CRT indications.

a. CG 3722	TRUNNION CDU DAC OUTPUT	0.00 \pm 0.19 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	0.00 \pm 0.19 degrees

6.2.21.3.26 Insert in K148

a. ENTER

6.2.21.3.27 Observe on CRT

a. V 33	N 03	Flashing
b. R1		-00090
c. R2		+00090
d. R3		+00003

6.2.21.3.28 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-3.93 \pm .24 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	+3.93 \pm .24 degrees

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6.2.21.3.29 Set the OPTICS MODE Switch on the Indicator Control panel to ZERO for 30 seconds, then return to MAN.

6.2.21.3.30 Insert in K148

a. ENTER

6.2.21.3.31 Observe on CRT

a. V 33	N 03	Flashing
b. R1		-00135
c. R2		+00135
d. R3		+00003

6.2.21.3.32 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-5.88 ±0.35 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	+5.88 ±0.35 degrees

6.2.21.3.33 Insert in K148

a. ENTER

6.2.21.3.34 Observe on CRT

a. V 33	N 03	Flashing
b. R1		-00160
c. R2		+00160
d. R3		+00003

6.2.21.3.35 Record CRT indications

a. CG 3722	TRUNNION CDU DAC OUTPUT	-6.95 ±0.41 degrees
b. CG 3721	SHAFT CDU DAC OUTPUT	+6.95 ±0.41 degrees

6.2.21.3.36 Insert in K148

a. ENTER

6.2.21.3.37 Observe on CRT

a. V 33	N 03	Flashing
b. R1		-00384
c. R2		+00384
d. R3		+00003

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6.2.21.3.38 Record CRT indications

- | | | | |
|----|---------|-------------------------|----------------------|
| a. | CG 3722 | TRUNNION CDU DAC OUTPUT | -16.88 ±1.00 degrees |
| b. | CG 3721 | SHAFT CDU DAC OUTPUT | +16.88 ±1.00 degrees |

6.2.21.3.39 Insert in K148

- | | |
|----|-------|
| a. | ENTER |
|----|-------|

6.2.21.3.40 Observe on CRT

- | | | | |
|----|------|------|----------|
| a. | V 33 | N 03 | Flashing |
| b. | R1 | | -00385 |
| c. | R2 | | +00385 |
| d. | R3 | | +00003 |

6.2.21.3.41 Record CRT indications

- | | | | |
|----|---------|-------------------------|----------------------|
| a. | CG 3722 | TRUNNION CDU DAC OUTPUT | -16.88 ±1.00 degrees |
| b. | CG 3721 | SHAFT CDU DAC OUTPUT | +16.88 ±1.00 degrees |

6.2.21.3.42 Insert in K148

- | | | | |
|----|--------|------|-------|
| a. | V 34 | | ENTER |
| b. | V 40 | N 20 | ENTER |
| c. | V 41 | N 20 | ENTER |
| d. | +00000 | | ENTER |
| e. | +00000 | | ENTER |
| f. | +00000 | | ENTER |

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APPENDIX I

<u>Signal</u>	<u>Nomenclature</u>	<u>G&N Test Requirement</u>	<u>PSAAM and/or SCA Uncertainty % of Full Scale</u>
CG 1020	+14 VDC CMC SUPPLY	+14.0 ± 0.4 VDC	0%
CG 1030	+4 VDC CMC SUPPLY	+4.00 ± 0.2 VDC	0%
CG 1040	+120 VDC PIPA SUPPLY	+120 ± 6.0 VDC	1%
CG 1051	+20 VDC PIPA SUPPLY	+20.0 ± 1.2 VDC	0%
CG 1052	-20 VDC PIPA SUPPLY	-20 ± 2 VDC	0%
CG 1070	+4 VDC CDU SUPPLY	+4.0 ± 0.2 VDC	0%
CG 1100	-28 VDC SUPPLY	-27.5 ± 6.0 VDC	0%
CG 1110	2.5 VDC TM BIAS	+2.5 ± 0.05 VDC	0%
CG 1201	IMU 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	1%
CG 1202	IMU 28V .8 KC 5% - 90° RMS	28.0 ± 1.4 VRMS	1.5%
CG 1203	IMU 28V .8KC 0° RMS	28.0 ± 2.1 VRMS	1.5%
CG 1207	PH DIFF IMU 5% 0°, -90°	90 ± 10°	3%
CG 1211	OPTX 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	1.5%
CG 1212	OPTX 28V .8KC 5% -90° RMS	28.00 ± 1.48 VRMS	1.5%
CG 1220	PH DIFF OPTX 1% IMU 1%	0° ± 10°	3%
CG 1331	3.2 KC 28V SUPPLY	28.6 ± 0.56 VRMS	1%
CG 1336	PH DIFF 3.2 KC 28V/CMC SYNC	0° ± 10°	3%
CG 1500	+28 VDC IMU OPERATE BUS	28.8 ± 3VDC	0%
CG 1510	+28 VDC IMU STANDBY BUS	28.8 ± 3 VDC	0%
CG 1520	+28 VDC CMC OPERATE BUS	28.8 ± 3 VDC	0%
CG 1530	+28 VDC OPTX OPERATE BUS	28.8 ± 3 VDC	0%
CG 2001	X PIPA SG O/P	5 VRMS max	3%
CG 2021	Y PIPA SG O/P	5 VRMS max	3%
CG 2041	Z PIPA SG O/P	5 VRMS max	3%
CG 2108	IG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2112	IG 1X RESOLVER O/P SIN	(18.38 ± 1.84) 19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2113	IG 1X RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2117	IG SERVO ERROR IN PHASE	0.0 ± 60mv RMS @ null	2%
CG 2120	IG TORQUE MOTOR CURRENT	0.125 amp max during Fine Alignment Torquing	2%
CG 2138	MG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2142	MG 1X RESOLVER O/P SIN	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2143	MG 1X RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2147	MG SERVO ERROR IN PHASE	0.0 ± 60 mv rms @ null	2%
CG 2150	MG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	2%
CG 2168	OG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2172	OG 1X RESOLVER O/P SIN	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2173	OG 1X RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2177	OG SERVO ERROR IN PHASE	0.0 ± 60mvRMS @ null	2%
CG 2180	OG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	2%

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<u>Signal</u>	<u>Nomenclature</u>	<u>G&N Test Requirement</u>	<u>PSAAM and/or SCA Uncertainty % of Full Scale</u>
CG 2219	PITCH ATT ERROR - CDU DAC O/P	5.06 ± 0.5 VRMS @ 17°	2%
CG 2220	IG CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 2221	IG CDU COARSE ERROR	0.0 ± 0.68 VRMS @null	1%
CG 2249	YAW ATT ERROR-CDU DAC O/P	5.06 ± 0.5VRMS @ 17°	2%
CG 2250	MG CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 2251	MG CDU COARSE ERROR	0.0 ± 0.68VRMS @ null	1%
CG 2279	ROLL ATT ERROR-CDU DAC O/P	5.06 ± 0.5VRMS @17°	2%
CG 2280	OG CDU FINE ERROR	0.0 ± 0.07 VRMS 2 null	1%
CG 2281	OG CDU COARSE ERROR	0.0 ± 0.68 VRMS	1%
CG 2300	PIPA TEMPERATURE	130 ± 1.5°F Operate Mode	0%
CG 3011	TRUNNION CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 3021	SHAFT CDU FINE ERROR	0.0 ± 0.07VRMS @ null	1%
CG 3117	SXT SHAFT SERVO ERROR IN PH	2 VRMS max	2%
CG 3118	SXT TRUNNION SERVO ERROR IN PHASE	2 VRMS max	2%
CG 3140	SXT SHAFT TACH O/P	3.1 ± 1.1VRMS @ Hi Rate	2%
CG 3145	SXT SHAFT MTR CONTROL WINDING	3.3 ± 1.3VRMS @ Hi Rate	2%
CG 3150	SXT TRUNNION TACH O/P	3.3 ± 1.3VRMS @ Hi Rate	2%
CG 3155	SXT TRUNNION MTR CONTROL WINDING	0.85 ± 0.35VRMS at Hi Rate	2%
CG 3160	SCT SHAFT TACH O/P	3.3 ± 1.3 VRMS @ Hi Rate	2%
CG 3170	SCT TRUNNION TACH O/P	0.85 ± 0.35VRMS @Hi Rate	2%
CG 3721	SHAFT CDU DAC O/P	5.06 ± 0.50VRMS @17°	1%
CG 3722	TRUNNION CDU DAC O/P	5.06 ± 0.50VRMS @ 17°	1%
CG 4300	CMC TEMP	75 ± 45°F	0%
CG 6020	PIPA CAL MODULE TEMP	57.5 ± 27.5°F	0%
CG 6021	IMU 800 cps 5% TEMP (PSA)	57.5 ± 27.5°F	0%
CG 2301	IRIG TEMPERATURE	135 ± 2.5°F in Operate	0%

All uncertainties specified above and those due to instrumentation in the ACE equipment shall be root sum squared with the basic system tolerances to yield an acceptable tolerance for use when testing the G&N System in the spacecraft.